Structure and Working of Science Models 2003

राष्ट्रीय शैक्षिक अनुसंधान और प्रशिक्षण परिषद्
NATIONAL COUNCIL OF EDUCATIONAL RESEARCH AND TRAINING

November 2003
Kartika 1925

PD 5T RNB

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Publication Team

Editorial . R.N Bhardwaj
Production Vikas B. Meshram

Cover
D K. Shinde

Published at the Publication Department by the Secretary, National Council of Educational Research and Training, Sri Aurobindo Marg, New Delhi 110 016, lasertypeset at in-house and printed at M/s Tarang Printers, B 50, Kishan Kunj Ext , Part II, Laxmi Nagar Delhi 110 092

Preface

In order to develop well defined abilities and skills such as spirit of inquiry, creativity, objectivity, courage to question, aesthetic sensibility, etc. the learning of science has been made compulsory for the first ten years of school education in the present 10 + 2 pattern of education However, even a well conceived formal system of education is not adequate to achieve the desired goals of science education. Rigid and theoretical lessons of the formal system, and the often inadequate demonstrations and experiments do not provide opportunity to the naturally curious children to indulge in the joys and fun of scientific investigation. Science Exhibitions offer an opportunity to the students to express and exchange their creative ideas, help them to learn the methods of science, provide them with opportunity to develop their problem solving skills and creative abilities

With these aims, the National Council of Educational Research and Training (NCERT) organises the Jawaharlal Nehru National Science Exhibition for Children (JNNSEC) as an annual function in collaboration with a particular State or Union Territory on rotation basis. The JNNSEC is the culmination of a series of exhibitions organised at zonal, district, regional and state levels and a large number of students and teachers participate in the event.

The present publication includes write-ups of a few exhibits selected for display in the thirtieth JNNSEC being organised in Dehradun, Uttaranchal. The write-ups of the exhibits are selected for those adjudged the best in the State level exhibitions held in 2002-2003 all over the country. It is a companion of another publication: "List of Exhibits" which contains the titles and synopsis of almost all the exhibits invited to participate in the JNNSEC-2003 It is hoped that this publication will motivate and help children to participate in future Science Exhibitions.

The write-ups contained in this publication were selected and edited by Prof I.P. Aggarwal, Prof. K B Gupta, Dr K.M. Pant, Shri R Joshi, Dr. Dinesh Kumar and Dr Gagan Gupta of the Department of Education in Science and Mathematics (DESM) of NCERT.

I appreciate their sincere efforts and specially thank Prof. K.B. Gupta for coordinating this work in 2003 and seeing this manuscript through the press. I also thank the Publication Department, NCERT for its cooperation in bringing out this publication and for the excellent production quality

R.D. SHUKLA
Professor and Head
Department of Education in
Science and Mathematics
National Council of Educational
Research and Training

New Delhi
October 2003

Contents

Preface *iii*

1. Injection Tubewell *1*
2. Heat Engine Sensor and Radiator *4*
3. Fixed Biogas Plant *6*
4. Single Phase Generator *8*
5. Improvised Economic and Multipurpose Furnace *10*
6. Solar Flour Sieving Machine *12*
7. Fresh Air Conditioning *14*
8. Page Turner for Physically Handicapped *16*
9. The World's Simplest FM Transmitter *19*
10. Environmental Pollution and Its Management *21*
11. Aerobic Purification of Sewage Water *24*
12. Generation of Electricity Through Tides *26*
13. Garbage Elutriator *28*
14. Automatic Light Controller in Railway Tunnels *30*
15. Three in One · More Efficient Multipurpose Chulah *33*
16. Digi Laser Communication *36*
17. Wino Solar Tech *40*
18. A Network of Models *43*
19. Internal Combustion Engine *48*
20. Nalgonda Technique for Defluoridation of Water *50*
21. Electro-Magnetic Crane *53*

22 गति अवरोधकों से विद्युत उत्पादन 55
23. मैनुअल वाटर पप 58
24 धूम्र अवक्षेपण यंत्र 60
25. विद्युत धारा के प्रभाव एवं उपयोग 62
26. रेल पथ विच्छेदन सूचक 67
27. जल संरक्षक एवं लघु जल विद्युत घर 70
28 सरल, सस्ता वाटर हीटर एवं गर्म पानी संग्राहक 75

1

Injection Tubewell

Students	Jatinder Singh Manwinder Singh	Govt High School Brahmna Di Bassian
Teacher	Om Prakash	Ropar, Punjab

Introduction

To meet the ever-increasing demand for ground water and to augment the ground water storage, we need proper management of rain water Roof top rain water and water flooding the roads can be harvested and stored in ground water reservoirs to recharge it. This is an ideal solution of water problem where there is inadequate supply of surface water. To utilise the rainfall run-off which goes to sewer or storm drain we need artificial measures. The roof top rain water of buildings is collected and injected into the aquifer, the water bearing formation. Sometimes the aquifer is overlain by impermeable clay layer making the natural percolation negligible. Then water has to be injected into ground water storage through artificial measures like our injection tubewell under atmospheric pressure. As ground water is bacteriologically pure, free of organic matter and soft and can be found everywhere. So the recharge of ground water is must for its prolong supply. The structure required for ground water recharge is simple, economical and eco-friendly.

Scientific Principle

The water level of a well is due to equivalent of hydrostatic pressure of ground water and atmospheric pressure As we draw more and more ground water from a well its hydrostatic pressure of ground water is reduced. Now we can put more water into the soil (aquifer) under higher atmospheric pressure. This atmospheric pressure used in injection tubewell to recharge the ground water by absorbing water by soil.

Materials Required

Main PVC pipe 65 cm long, dia 4 cm; two side ways PVC pipes 10 cm long, 2 cm dia and with holes, sand, clay, gravel, boulders, G I. sheet box 2'× 2'× 2' with front side glass; thermocol, and 6 V dc motor.

Construction

The main PVC pipe is fitted with two side ways holed pipes near its upper end at an angle 15° on both sides as shown in Fig. 1 1

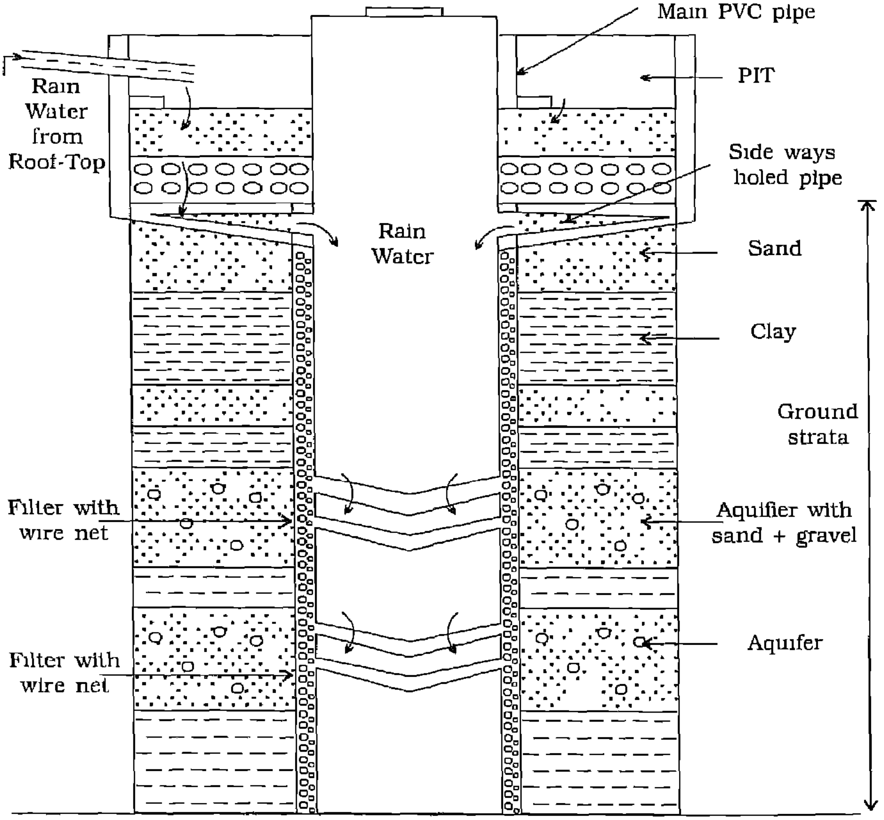


Fig. 1.1

The GI sheet box is filled with different layers of sand, clay, gravel and boulders after putting the main and side ways PVC pipes in it. The roof of thermocol building is attached to the pit fitted at the top of G.I. sheet box through a pipe Water is shovered over the building to show as rainfall A 6 V dc motor fitted with a pipe system act as pump to draw water from the aquifer.

Working

When rainfall (showered water) falls on the roof top of the building water is collected by a pipe and supplied to the pit box fitted at the top of the G.I sheet box. The water from the pit above and GI box is collected by two holed side ways PVC pipes and supplied to the main pipe The water passes through sand and gravel layer and then boulders layer before entering into the main pipe Due to atmospheric pressure and under gravity this water goes to the aquifer layer of sand and gravel through the filter of wire net and the recharge of aquifer can be proved by drawing water through the pump again and again.

2

Heat Engine Sensor and Radiator

Student Ranjan Kumar Singh
Teacher · Gopinath Pradhan

Janta High School
At P O Kuhuri
Distt Khurda
Orissa

Introduction

Lower conversion efficiencies of motors and engines lead to a wastage of fuel as heat This model demonstrates a novel technique, designed to give an increased conversion efficiency (fuel to power) and also for neutralising the heat generated by the engine. This technique proposes the disposal uses the disposal of heat both by conduction and convection methods in a modified radiator This gadget is proposed to have three main components, viz., heat receiver, heat controller and heat neutraliser.

1.1 *Heat Receiver :* Heat receiver consists of three parts, viz., heat source, sensor and conveyor. The main material requirements and a heater (1000 W / 230 V), a Si n-p-n transistor, shielded copper rod and a 9 V dc compressor fan.

The heater is used as heat source. The heat is sensed by a sensor made up of n-p-n transistor The sensed heat is then transmitted to heat controller section through a good conductor copper rod. Here an improvised heat conveyor section is also attached as shown in Fig. 2.1.

2.1 *Heat Controller :* This also consists of three parts, viz., a digital thermometer (Tr -ql: 2N 2222 with CB shorted), a thermostat and a potentiometer (VR – 1 type 7312) The heat sensor (2N 2222 TC1: LN 339) of heat receiver is connected to thermometer. The

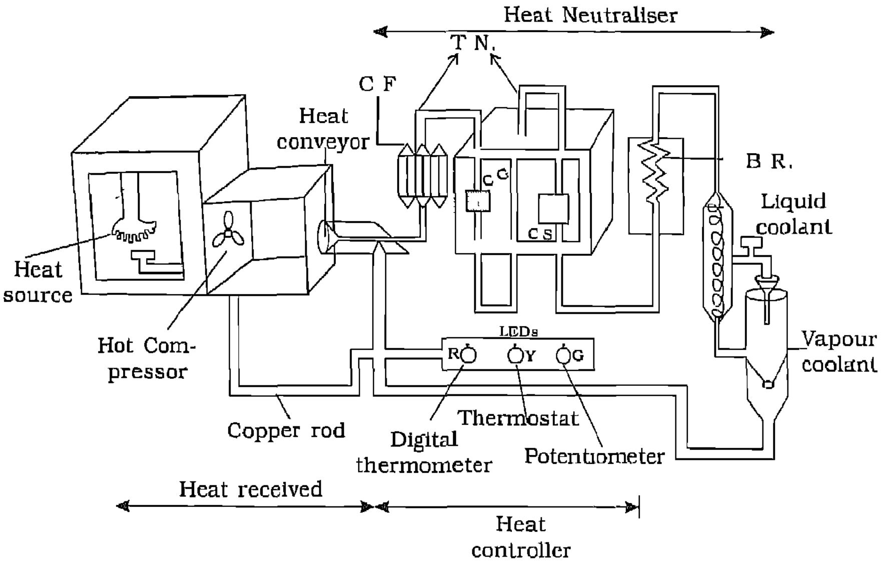


Fig. 2.1

heat controller based on thermostat, compressor and the electrical devises restricts the temperature variation in the engine. Potentiometer is used to limit the allowable temperature variation range.

3.1 *Heat Neutraliser* : This consists of a radiator (cooling fin-CF), cooling gauze (C.G), cooling sieve (CS), and a black body radiator (BR) is shown in Fig. 2.1. Liquid ammonia NH_3; lizard CO_2 or Freon is used as liquid coolant for a rapid removal of heat This heat engine sensor and radiator is a very compact and cheap device and operates automatically within a liquid – vapour phase cycle.

3

Fixed Biogas Plant

Student . Rongsen Temjen

St. John's School
Tuensang
Nagaland

Introduction

This model exhibits a biogas plant in which the biogas is produced using an anaerobic fermentation of biomass. The biogas mainly contains methane and can be used for household purposes

Materials Required

A plastic tin container of capacity 20 litres, an inlet pipe (PVC) 1' long and 1"dia; an outlet pipe (PVC) of 2" dia and 10' long; gas outlet pipe with a valve, and mixing tank and other raw materials required to produce biogas such as cow dung, human dung, plant and animal matter etc.

Construction

A plastic container can be used as digester. Make a hole of diameter 1" on one side of the container at a height of 2 feet from the bottom and fix at an angle of 45°. Attach the mixing tank to the other free end of the pipe Now, make another hole of diameter 2" on the opposite side of the container at a height of 2" from the bottom Fix the outlet pipe of diameter 2" and the length 10" through this hole at an angle of 30° Now fix the gas outlet pipe with a valve at the top of the container.

Working

Cattle dung and water are mixed in equal proportions in the mixing tank to obtain slurry. The slurry is fed to the digester through the inlet pipe The dung undergoes anaerobic fermentation in the digester producing biogas, which can be collected through the gas outlet pipe.

Conclusion

The devices like biogas plant help to recycle wastes and conserve non-renewable sources of energy. In remote states like Nagaland, a lot of forests are being destroyed day-by-day for firewood. The biogas plants can thus minimise deforestation.

4

Single Phase Generator

Student Rohlupuii
Teacher · T. Hrangsiama

Govt PCR high School
Serchhip
Mizoram

Description

This device is a Single Phase Generator A single phase Generator means a machine that produces electricity by Single Line current. It works on the Principle of Electromagnetic Induction, the electric so produced lasts only so long as there is relative motion between magnetic flux and coil of insulated wires

By this principle, the rotor magnet (Permanent or Electromagnet) is rotating on its axis and the magnetic flux cut coils of insulated wires induce electromotive force in the coil. The Electric Current so produced is called induced current.

The rotor magnet can be rotated by any mechanical means (i.e. By hand or by wind mill or by hydro turbine or heat engines) To generate more power, more mechanical force and more heavy machine is required.

Construction

A single phase Generator consists of mainly two parts, the rotor and stator The rotor produces revolving magnetic flux when it rotates by its axis. The stator is fixed in which coil (or coils) of insulated wire is wound laminated soft iron for circulation of magnetic flux. The insulated coils are fixed so close to the revolving magnet, i.e., the rotor at equi-distance and the coils are inter connected in series, the other two terminals of coils are kept open

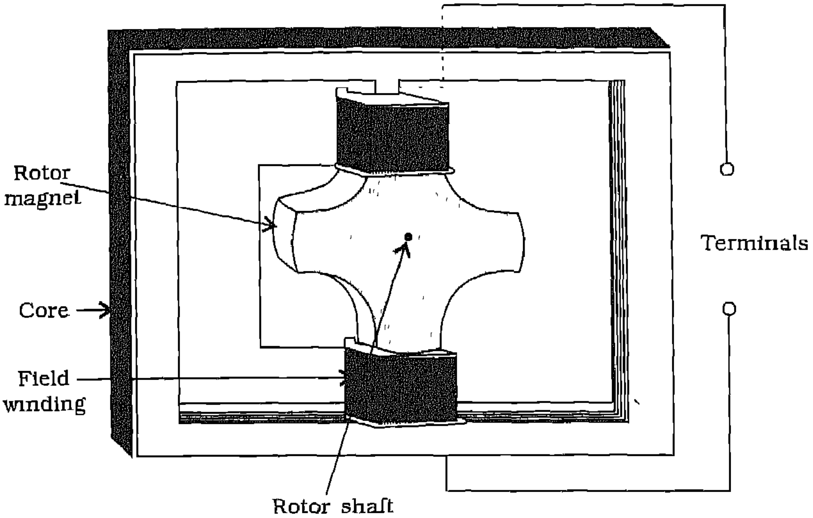


Fig. 4.1

in which a load of bulb or other electric appliances are connected to make closed circuit. When the rotor rotates around the coils, e.m.f. is produced and induced current is flowing along the closed circuit

The current induced is directly proportional to the .

(i) speed of relative motion between stator and rotor;
(ii) intensitiveness of Magnetic field;
(iii) number of turns in the winding.

The quality of electric produced is called Power output which is a product of Voltage × Current

5

Improvised Economic and Multipurpose Furnace

Student Belester Iawphnraw
Sibsingh Memorial Govt
Higher Secondary School
Nongstoin
West Khasi Hills
Meghalaya

Teacher F K. Nongrum

Introduction

Human's endeavour for a better economic development is never ending and in the process, human has ruthlessly plundered of mother nature leaving it in a very pathetic state. At present most of the natural resources are being partly depleted and it is high time for the present generation to find ways and means to conserve them Making maximum use of the energy by using minimal amount is the main idea of this model.

The furnace designed is a very simple one having many functions, which can be performed at one time. The heat emitted from the firebox is transferred by convection to all parts of the furnace thus enabling a person to perform a number of works at a time thus saving energy, time and money.

Materials Required

Firebricks, sand, cement, thick iron plates, doors and hot plates and a square iron water tank.

Construction

We built a firebrick tunnel, 4 feet long inside the house kitchen It is bricked off at the back, but the front falls 4 inches short of the exterior house wall. The house wall there is lined with firebricks. On either side of the tunnel we built a brick wall slightly higher than the top of the tunnel. The bases of these need not be of firebrick, but the tops must be to withstand the heat. On top of the two outer walls we laid a cast iron plate This goes from the back of the furnace right to the wall of the building. On top of the cast iron plate away from the wall of the building we built an oven, and at the very farthest end from the wall a chimney has been built. The chimney has a smoking box and a drying box in it with air tight doors fitted in the various parts of the furnace We built a back boiler into the back wall of the tunnel, and the pipes from it come back between the tunnel wall and the outer wall, and then come out through two holes in the later We partially fill the cavity between and outer walls with sand to insulate and accumulate heat

The furnace is fed with firewood and as the fire is started the heat emitted is transferred to the iron plate, oven and to the back boiler then the heat in the form of flme and smoke tries to escape and in the process passes through the different compartments of the furnace thereby providing the later with enough heat. The main advantage of this furnace is its capability to make charcoal. While burning firewood in the furnace, at times the wood is wasted so in order to prevent this, the firebox door is closed allowing a very little amount of air to enter the firebox This helps to make charcoal from the half burnt firewood.

This furnace is very applicable mostly in rural areas where the supply of other types of fuels like LPG and kerosene is not easily available and where firewood is the main source of fuel. Such a furnace would help the people to perform different kinds of works from cooking, hot plate roasting, baking, steaming meat and other eatables, drying clothes during the rainy season, heating water and even storing foodgrains.

6

Solar Flour Sieving Machine

Student : Letkhotinthang
Teacher K. Meghachandra Singh

St Mary's High School
Churachandpur 795 128
Manipur

Introduction

Separation of larger size particles of flour from wheat flour, rice flour, atta flour etc. is needed. The proposed machine fulfils this task without requiring any physical input to sieve the flour and also in much lesser time. This machine can also be operated by an invalid or a handicapped person.

The scientific principle involved in the machine is that the rotary motion of a d.c motor is transferred to a flywheel; the flywheel gives to and fro motion to the siever, which sieves the flour.

Materials Required

Iron frame, wooden platform; two iron posts with two holes, an iron ring with two support rods made of 0.5 cm iron rod; one 6 V d.c. motor; one tape recorder flywheel with its axis; a connecting plate; a plastic siever; solar cell, storage battery etc.

Construction and Working

A wooden plank is fixed on an iron frame. An iron plate is fixed with an electric 6 V d c. Motor and equivalent flywheel is mounted on the wooden platform (The detailed structure is shown in Fig. 6 1).

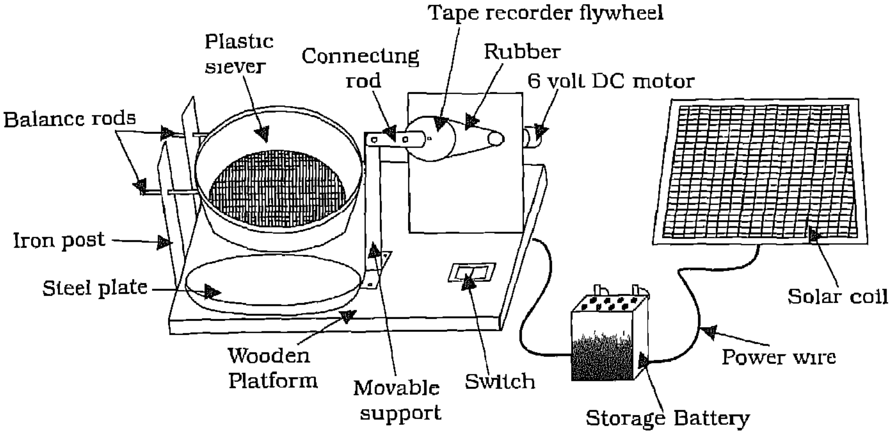


Fig. 6.1

The flywheel connects the ring supported by the two posts at the side with the help of connecting plate. A plastic siever is kept inside the ring. The rotatory motion of the d c. motor is transferred to a flywheel The flywheel converts the rotatory motion into to and fro motion of the ring using a connecting plate to the ring. The to and fro motions of the ring quickly sieve the flour from the plastic siever.

7

Fresh Air Conditioning

Student L Bineshori Devi
Teacher S. Ingocha Singh

Jawahar Navodaya
Vidyalaya
Khumbong 795 113
Imphal West
Manipur

Introdution

The increasing environmental pollution in metropolitan and other bigger cities and in many industrial areas of the country is a grave concern for all It is the need of the hour to realise its long-term effect on human beings besides plants and animals Therefore, this exhibit "Fresh Air Conditioner" has been designed to create a know-how to purify the air containing harmful substances like Carbon-di-oxide, dust etc., which are increasing alarmingly due to the steep rise in population as well as the changing lifestyle of the people. Here, a fan is used to pull the air through metallic plates, which are charged positive and negative substances, and toxic gases are absorbed and we get purified air. Then the purified air is passed to the air conditioner and also supplied all the rooms of the house The working of this exhibit is based on the phenomenon of mutual induction; an electromagnetic field is induced in the neighbouring circuit, when the strength of current through a circuit changes.

Materials Required

Electric fan, cooling coil, heating coil, metallic plate, wood, battery, induction coil filter of different gauge etc.

Construction

In the construction of this "Fresh Air Conditioning" exhibit, we use an induction coil. The coil acts as the supplier of the air through the metallic plates, which are connected to the positive and negative terminals of the induced electromagnetic field Then the air purifier is connected with the air conditioning unit as shown in Fig 7.1

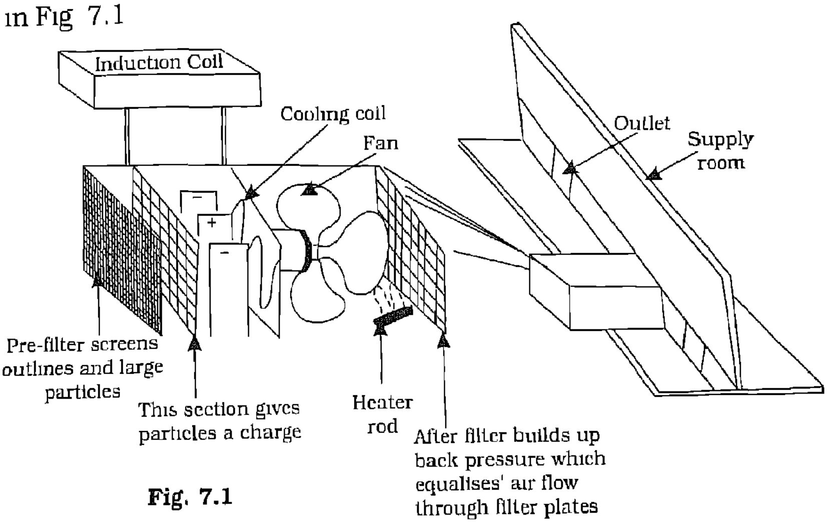

Induction Coil
Cooling coil
Fan
Outlet
Supply room
Pre-filter screens outlines and large particles
This section gives particles a charge
Heater rod
After filter builds up back pressure which equalises' air flow through filter plates
+
-

Fig. 7.1

Working

Inside the induction coil, when the current passes through the primary coil, the soft iron coil is magnetised. It attracts the nail as the nail moves towards the core. Thus the contact between nail and the screw is broken. As a result of it, the current in the primary coil stops, the iron core is demagnetised and the nail is no more acted upon by the attractive force. Due to the elasticity of the spring the nail comes to its initial position and establishes contact with the screw and therefore the current in the primary coil again begins to flow This process is repeated again and again. When the current passes through primary coil during rises and decays during break, induced electromagnetic field is produced in secondary coil across the positive and the negative terminals, which are connected to the metallic plates consecutively. When the fan is in operation, air from the house is pulled through first filter with small gauge and in this stage, larger particles like leaves in air are taken out and then the air comes towards the second filter with large gauge which is connected to the negative terminal of the transformer. Thus, we get fresh air to the air conditioning unit

8

Page Turner for Physically Handicapped

Student Shah Khushbu Yaswant Bhai

Teacher : Sonita Prakash Sansare

Sir B.J Girls School
291, 292
Jawahar Nagar
Goregaon (W)
Mumbai 400 062

Introduction

Disabled people and the people with Parkinson's diseases, Multiple Sclerosis, Cerebral Palsy, Paralysis and other similar medical conditions have lot of restrictions on their movements. It can be visualised if one imagines lying one one's back, incapable of moving anything but head People in such a plight cannot even look around the room they are lying in, the only thing left is contemplation of their misfortune — often leading to mental strain and involving others surrounding them in great physical efforts to make them bearable.

Page-turner is a concept of an electro-mechanical device, which will enable physically disabled people to turn pages of a book It will be operated by chin or leg.

Thus they will be able to control their environment and interact with others with confidence It will build a sense of self esteem which is very crucial in their recovery.

With few add-ons, it can also be useful to musicians who don't always have a free hand for turning the pages of their music while they are playing A page-turner must have following features:

- Forward and backward turning
- Single and multi-page turning
- Different sized books adjustment
- Cost economy
- Chin operated or leg operated
- Portable.

Working

Scientific principle — Friction . As shown in the figure, the book will be clamped on the inclined board. The entire assembly mechanism is pivoted centrally on the carrier. A long shaft which carries a rubber wheel is used for riffling the pages The shaft moves on the ramp on the carrier so that the riffling wheel will the spine of the book and will not crease the pages near the center. Two stoppers are provided to stop the motion of the shaft at both ends.

Control box has two hinged lids and it controls the movement of the riffling wheel When the 'right lid' is pressed by chin, the wheel moves to the right side of the operator. Now, the shaft is prevented from turning any further by means of the stopper. But due to its pivoted mechanism, it continues to rotate and wheel riffles the corner of the page. Now, the 'right lid' is released and motor is stopped when the corner of the page is completely released.

Leg or chin presses 'left lid' and the shaft with the wheel, progresses to the left side of the operator pushing the released page across and in effect, turning the page over.

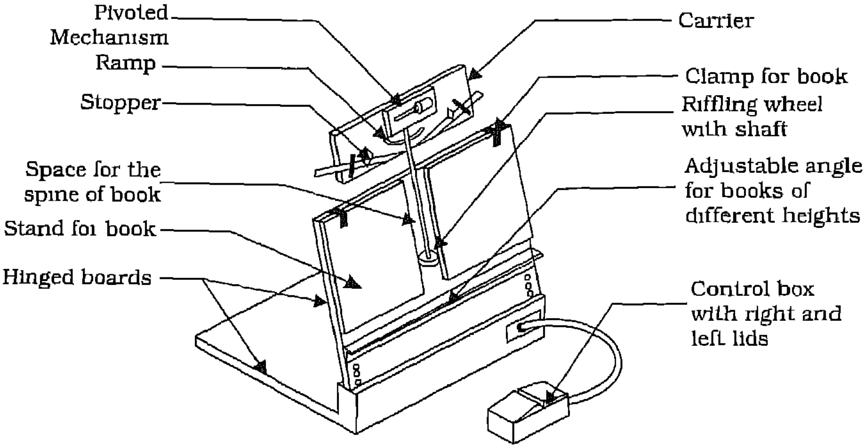

Pivoted Mechanism
Ramp
Stopper
Space for the spine of book
Stand for book
Hinged boards
Carrier
Clamp for book
Riffling wheel with shaft
Adjustable angle for books of different heights
Control box with right and left lids

Fig. 8.1

Advantages

- Easy forward and backward turning
- Single and multi-page turning
- Different sized books accommodation using adjustable angle
- Maximum 25 seconds operation time
- Light weight, hence portable
- Battery operated hence, electrically safe
- Cost economic, only 4 per cent of average cost of globally available page turners.

Limitations

- Some skill required to operate
- Assistance needed to insert and position the book

Extensibility

- Carrier height can be made adjustable
- Eliminator (3 volts) can be used
- Speed regulator and timer may be installed
- Can be modified specially for musicians.

9

The World's Simplest FM Transmitter

Student : Owais Bhat

SSM Higher
Secondary School
Parray-Poar, Srinagar, J&K

Teachers Riyaz-Ul-Rehman
Ajaz Ahmad Malik

Introduction

It is the simplest and low cost multipurpose model of a FM transmitter-cum-cordless microphone. It can be used to send messages up to a certain distance. The simplest scheme used here involves conversion of speech or music to be transmitted to electrical signals using a microphone. The electrical signals are then boosted up. The amplified audio signal is superimposed on a high Frequency carrier wave. The modulated wave is then transmitted in space, with the help of an Antenna. At the receiver end, these signals are picked up, demodulated and fed to loudspeaker to produce original speech or music.

Materials Used

Different resistors of values like 1 kΩ, 10kΩ, 39kΩ, 10Ω, Different capacitors of values like 2.2 pF, 15 pF, 4.7 pF, 103 pF, 68 pF, 102 pF, 4.7 pF, transistor - 2N2369; Condenser mic; antenna, 2 pencil cells of 1.5 V; and enameled copper wire and connecting wires.

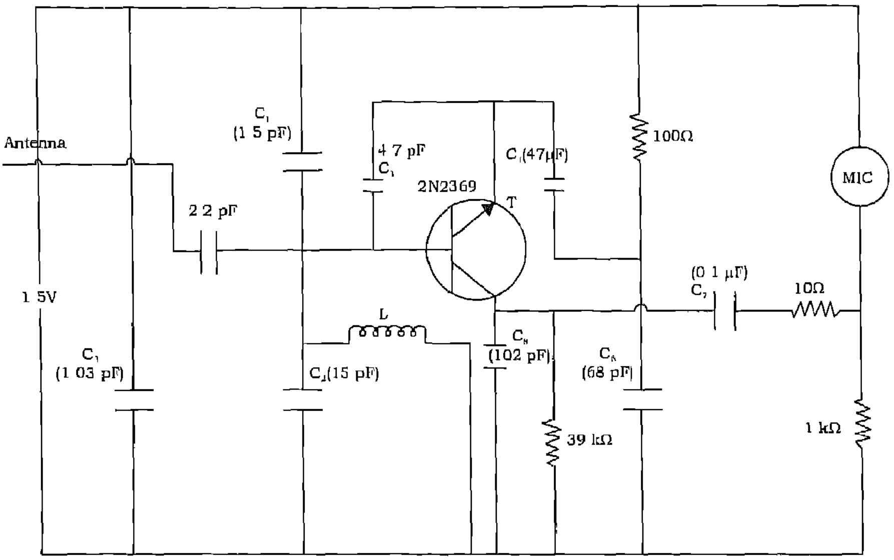


Fig. 9.1

Construction and Working

The circuit of the FM transmitter-cum-cordless microphone is shown in Fig 9.1. Transmitted signals having frequency in the range 90 MHz are being FM modulated so one can receive the voice through a standard FM radio receiver (88-108 MHz). The heart of the circuit is a transistor (T), which not only amplifies the signals but also acts as an oscillator along with the passive components like capacitors and inductor coil. The air core is a high frequency coil consisting of six closely wound turns of 25-swg enameled copper wire. The range of transmitter can be enhanced by connecting a 30-60 cm long wire as antenna and by changing the value of capacitor (C8) to few µf In order to improve the circuit and its range another transistor (T1) can also be coupled with the transistor (T) The circuit is so simple and small that it can be accommodated even in a matchbox.

10

Environmental Pollution and Its Management

Students : Varsha Sharma
Rahul Rana
Shwait Sharma

Little Angel Academy
Kishtwar
P.O. Kishtwar
Distt Doda
J & K 182 204

Introduction

Environmental safety is a major area of activity and concern now and a proper management system of environment is to be developed and made aware to all. This exhibit envisages the development of a low-cost and improvised water-, air-, and noise-pollution detectors.

Scientific Principle

Passage of current through impure water leads to the deposition of dissolved salts around electrodes. The measurement of concentration of these salts gives a mechanism for the detection of impurities in water or testing water quality.

Conversion of sound (mechanical) energy into electrical energy (by using a microphone, say) gives a mechanism for the detection of sound noise – levels

Materials Required

Plastic sheet, plaster of paris, thermocol sheets, cardboard sheets, wool, toys, small plants, beads, different colours and related material, 5 resistors, 5 capacitors, diodes and 3 V dc batteries, 2 sensing probes, ammeter and connecting wires.

Construction and Working

Water-Pollution Detector · Water used for household, agricultural and industrial purposes when discharged after usage is polluted with soluble, insoluble matter and pathogens

The model consists of a water quality checker to test any dissolved ions in a given water sample In this model we have connected two sensing probes fitted on the cardboard with an ammeter and a battery of 3 V dc (Fig. 10 1). A light emitting diode and resistor are also fixed on the cardboard. To see the working of this water quality checker, the sensing probes are to be dipped in a pure water sample The pointer of the micrometer shows deflection

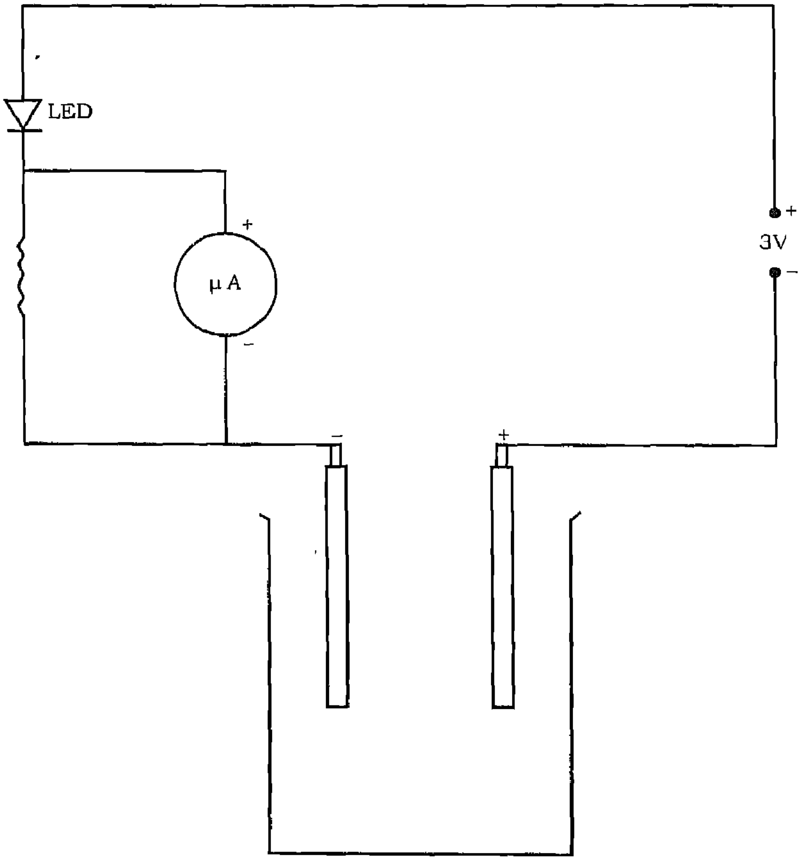


Fig. 10.1

Air-Pollution Detector The occurrence of foreign particles or gases in the atmosphere which are harmful to human, vegetation, animals or buildings is referred to as air pollution. In our model, we have used some plants as indicators of air pollution. Lichens, mosses are much sensitive to SO_2. Lichens do not survive in areas exposed to SO_2 for a long time Similarly, Pinus (Gymnosperm) is sensitive to SO_2 and hydrogen fluoride pollution. Light spots are seen near the margins of veins by the killing of the tissue Fluorides destroy the leaf tissue.

Noise-Pollution Detector · A simple noise-pollution detector has also been devised which tells us about the noise level in the atmosphere (Fig. 10.2) We have connected a speaker with a micrometer through two transistors, five resistances, five capacitors, a diode and a 3 V dc battery. When some sound strikes the diaphragm of the speaker, it gets converted into electric current. This current is measured by the micrometer When the loudness is low, the deflection of the pointer is less and vice-versa.

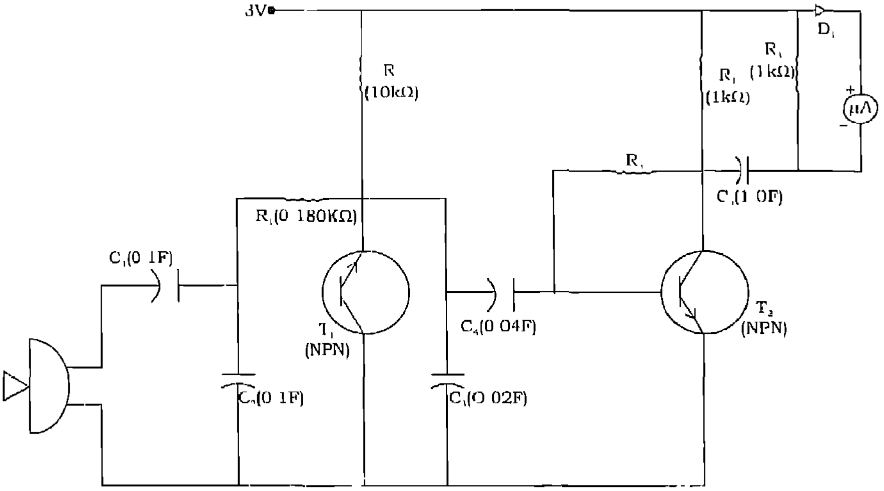


Fig. 10.2

11

Aerobic Purification of Sewage Water

Students G Goutam
K Abhiney
Teachers M. Narasimha Chary
V J. Clement

Vijay High School
Mubarak Nagar
Distt. Nizamabad
Andhra Pradesh

Introduction

In this exhibit a simple aerobic technique to clean the sewage water to be used for agriculture, gardening, etc. purposes is demonstrated. This technique may also be employed for purifying the sewage water to make it potable.

Materials Required

Plastic tanks, aquarium pipes; aquatic organisms (e.g. fish, prawns etc); aerators and water plants like hydrilla or nostoc, anabena

Working

The water coming out from house kitchens, toilets etc., is first collected in a settlement tank (Fig 11.1). In this tank denser impurities are settled at the bottom The sewage water is first treated in an aerobic tank in which aerators are employed to develop aerobic bacteria (which need air for their existence) by the process of oxidation Thus the complex organic molecules decompose into simple molecules. This water is sent to a resettlement tank where suspended particles are being further

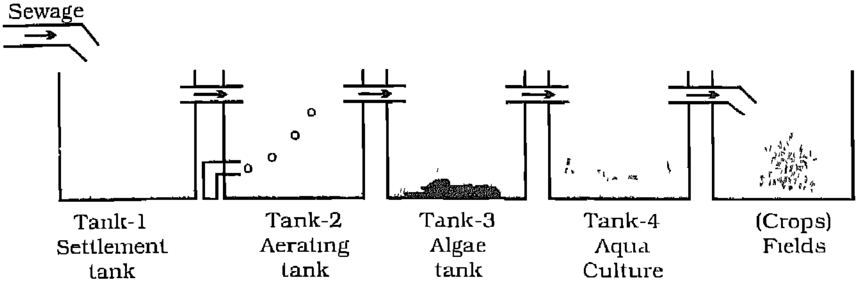


Fig. 11.1

separated Now this is sent to algae culture tank. Here some water plants like hydrilla and nostoc, anabena are grown which by means of respiration increase the amount of dissolved oxygen in water This oxygen enriched water is then treated by means of aqua culture The aquatic organisms like fishes and prawns by using dissolved oxygen remove the suspended amino-acids and other organic materials from the water. The water may then also be chlorinated.

12

Generation of Electricity Through Tides

Students : Jyoti Chowdry
Jyoti Sharma
Teacher : Kamlesh Sehgal

Govt Girls High School
Domana
Jammu, J & K

Introduction

This model has been developed to generate electricity by using the energy of tidal waves in oceans or seas

Material Required

A wooden board, aluminium sheet(s), a water tank, water pump, flywheel, circular disc, wooden blocks, nails, floating masses, crank shaft, electric bulb, thermocol sheets and connecting wires

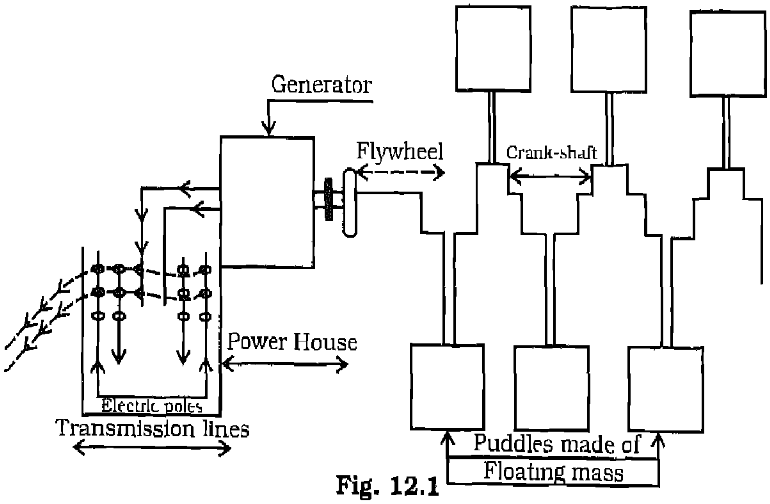


Fig. 12.1

Principle and Working

The high kinetic energy of the tidal waves is converted into electrical energy by allowing them to interact with a water turbine Thus the tidal energy is converted into rotational kinetic energy of turbine blades The rotation of turbine blades and then shaft through a magnetic flux generates electricity (in an electric generator).

In our model the replica of tidal waves is produced by rotating paddles or floating masses in a tank by means of a water pump (Fig. 12 1) The crankshaft attached with these masses rotates circularly and that drives electricity current in the generator.

13

Garbage Elutriator

Student S Harisankar
Teacher Jitha K Nair

Jawahar Navodaya Vidyalaya
Vechoochira, Pathanamthitta
Kerala

Introduction

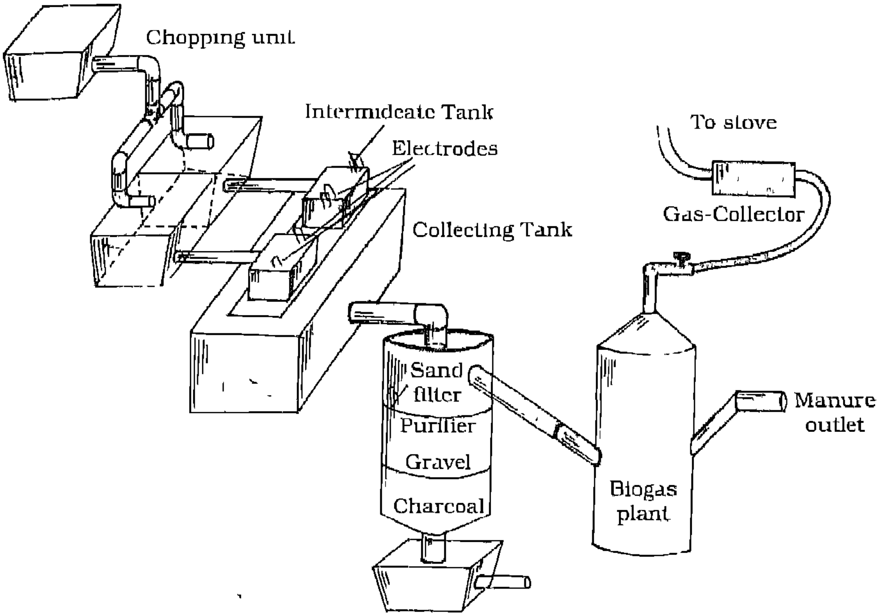
The disposal of wastage and garbage from houses has been a matter of concern as these are sources of environmental pollution. In this exhibit we demonstrate an alternative method to use this garbage and waste products for the production of useful energy. This method can be employed for the production of electricity and biogas in recycling of water and lastly into the production of manure.

Principle and Working

The exhibit is divided into a chopping unit, intermediate tank, collecting tank, filtering tank, purifier tank, water collector, biogas plant, gas collection unit, burner etc. (as shown in Fig 13.1)

The solid garbage such as kitchen waste is first sliced into smaller pieces in the chopping unit. The waste particles or the waste water also kept in an intermediate tank

The collector unit collects water either from the toilet, kitchen and also collects the chopped waste from the chopping unit. This waste is kept into various 'electrolytic cells' to generate electrical energy. Here the acidic waste water acts as electrolytic solution. From these cells we have been able to obtain emf of about 1.5 V,



Water collector

Fig. 13.1

which is higher than the emf as offered by many other primary cells

The waste water in them brought in a filtering unit of the plant. The first compartment of it is filled with sand. The outlet of this compartment gives the water which is suitable for irrigation purposes The second compartment of the filtering unit is filled with gravel, the output of which is suitable for household (but not potable) purposes The third compartment of the filtering tank is filled with charcoal. The net output of the third compartment may become potable after necessary chlorination. Obviously, the solid wastage is taken out from this filtering unit after every regular interval

The unused waste is brought in biogas plant where anaerobic fermentation of waste by means of bacterial processes produces methane gas, that can be used for cooking, etc. The dried residue from this biogas would be used as manure.

14

Automatic Light Controller in Railway Tunnels

Student · Ankit Kulkarni
Teachers Shri R. Sharma
Shri P K Thukral

Kendriya Vidyalaya No 2
Air Force Station
Pune 411 032

Introduction

The working of an automatic switching system of lights in a railway tunnel with the entrance and exit of a train has been demonstrated Case studies of Mumbai-Pune (Central Railway) and Mumbai-Mangalore (Konkan Railways) routes, which have 26 and 92 tunnels, respectively, along their paths have been taken into consideration. The basic scientific principle involved here is the conduction of current through closed circuits.

Materials Required

Toy train with tracks, 1 5 meter × 1 meter plywood, 3 5 feet PVC pipe cut into shape of tunnels , 4 torch bulb holders with 2.2 W bulbs, dry battery bank (9 V) copper strip on the tracks and toys for relevant decoration / display.

Construction

The exhibit constitutes a simple series circuit of 4 bulbs (2.2 W each) with the battery supply voltage of 9 V. Two copper strips are laid on the plastic tracks fitted on the plywood. One terminal of the battery is connected to one end of copper strip (track) and the other terminal is connected to second copper strip (track) through 4 bulbs placed in series inside the PVC tunnels Toy train with the metallic wheels (herein 10 paisa coins are used) is made to move on the track with its dry cell battery power supply

Working

Toy train is made to run on the track When metallic wheels of train come in contact with the copper strip the electric circuit is completed and bulbs in the PVC tunnels start glowing (Fig 14 1). When the train leaves the tunnel then the bulbs in tunnel are automatically switched off (Fig. 14 2). Bulbs are fitted only in the tunnel The tunnels with lengths less than 100 m are not provided with lights.

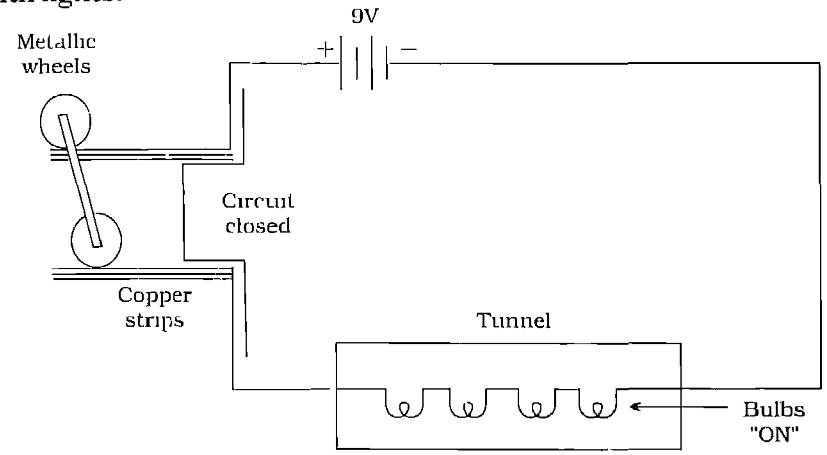


Fig. 14.1

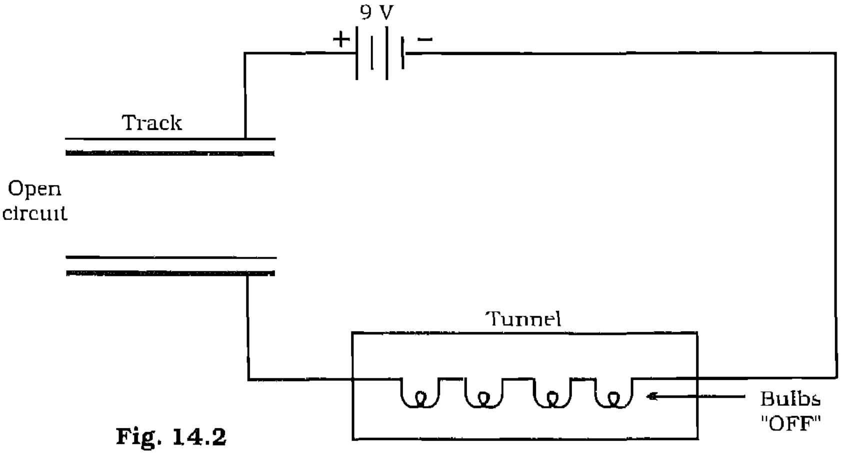


Fig. 14.2

Application

Application of this simple circuit can be done in various tunnels of Indian Railways. Indian Railways has one of the largest network in the world. There are several tunnels all over the railway routes with lengths ranging from 100 m to 6.5 km. 'Kharbwde' is the longest tunnel with length of 6.5 km in Konkan Railways. With the application of light controller the consumption of electrical energy can be conserved / controlled to a large extent. And also the wear / tear and life of the components used for electrification can be prolonged. Data of Mumbai-Pune railway route was collected to bring out the case study and highlight the importance of the exhibit.

No. of tunnels on Mumbai-Pune route = 26
Length of the longest tunnel = 2 km
Length of the shortest tunnel = 100 m (wherein no-electrification / illumination is necessary)
Bulb wattage = 70 W
Distance between bulb fittings = 10 m. (Variation in distance in case of straight tunnels)

Sample Calculation of Energy consumption in the longest tunnel

$70 \text{ W} \times 200$ (No. of bulbs) = 14,000 W
Consumption per day : $14{,}000 \text{ W}\Omega \times 24 \text{ hr}$ = 3,36,000 W hr.
Consumption per year : $3{,}36{,}000 \times 365$ = 1.23×10^{8} W hr
= 1.23×10^{5} Units

15

Three in One : More Efficient Multipurpose Chulah

Students Kumar Bhargava Commercial Sr. Secondary School
Rishabh Kushwaha 24, Daryaganj
New Delhi
Teacher Vishva Mohar Jain

Introduction

About 70 per cent people of whole India's population live in villages, and still nowadays most of village people uses the same traditional Chulah for the cooking purpose producing a lot of smoke and difficulties It becomes difficult to sit and cook the food in such a smoky front of chulah Most of them even can not dream of using fuels like L.P G , Kerosene oil etc., as they do not have money to buy and to maintain the equipments required to use this fuel so they have to depend on traditional fuel for their daily requirements for this purpose

Even today most of village people depend on traditional chulah made by joining bricks in proper manners, and uses fire woods, dung cakes, agricultural wastes etc , as fuel This chulah works on very low efficiency (10 per cent-20 per cent) because of incomplete combustion of fuel, this causes the following different type of hazards

1. Lot of air pollution;
2. Lot of smoke,
3. Respiratory problems in women cooking food on them;
4. Diseases like Asthma, High B.P , Low B.P., and many ot

Aim

In this chulah we have tried to overcome this problem to some extent and to extend scientific renovation to the common people on a very low extra expenses

Construction

We have raised the level of our chulah by about 4 cms and have made a large number of holes in its base. This raised level of base and perforation helps in better combustion of fuel (wood, dung cake, agricultural waste etc) by providing extra air (having oxygen the supporter of combustion) from the holes in bottom. This causes low pollution and also maintains hygienic environment

A hollow copper pipe has been laid side by side on the steel walls of chulah in spiral form. The lower end of this pipe has been connected to a water tank. This pipe circulates this water in pipe and its upper end works as the output of the water Further the copper pipe has been burrowed under a thick layer of dry earth. Dry earth being an insulator of heat prevents the heat loss through the walls of chulah This burrowed copper pipe works as heating device of water (geyser) for no extra cost.

Further this chulah has been enclosed in an enclosure open from front only. This enclosure is made of an insulating material. This enclosure prevents the heat loss to the surrounding At the upper side of the enclosure a box has been made The base of this box is made of a wire mesh This wire mesh allows the passage to hot gases through it. These hot gases heat the food content put in it in covered containers. The top of this box is fitted with a chimney, which allow the exhaust gases to escape to the atmosphere. This box works as a hot case

Working

When fuel is burnt in this chulah its better combustion takes place ause of its raised level and perforation in the base plate The t absorbed by its wall heats up the water flowing through the per pipe laid by side of its walls. This hot water can be used or different household purposes like bathing, washing and cleaning of utensils etc.

Heat lost to the environment is enclosed in the enclosure of heat insulating material. Hot air being lighter rises up and reaches the hot case through wire mesh at its base This hot air heats the

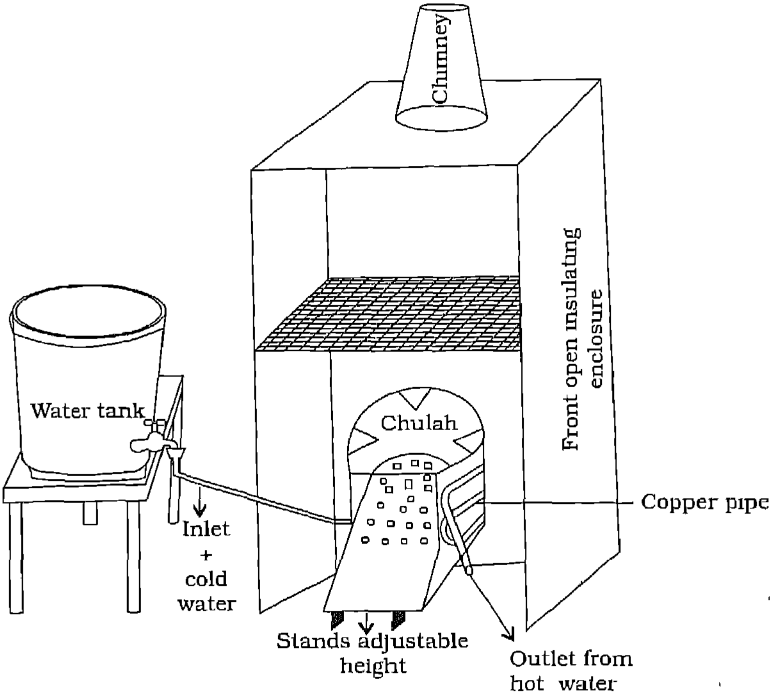


Fig. 15.1

food material placed inside the hot case and keeps them warm for a longer time even after cooking by chulah has been stopped.

The left out gases come to the atmosphere through the chimney and maintain the hygienic environment.

Thus by slight improvisation in the traditional chulah it can be converted to multipurpose and more efficient chulah providing three comforts

Advantage

If the proposed chulah is used in the rural areas they will get some comforts to some an extent and this will play a sharing hand in the development of country by saving the fuels So this technique should be upheld for saving the energy and money.

16

Digi Laser Communication

Students : Jasmeet Singh
Gaurav Saxena

Teacher . Reema Tandon

Kamal Public Sr. Sec. School
D-Block, Vikas Puri
New Delhi

Introduction

The word laser stands for light amplification by the Stimulated Emission or Radiation. A laser uses ordinary light and amplifiers it by stimulating atoms to release light altogether exactly in phase. Energy put into the Laser exits electrons in atoms. As an excited electron falls back to its normal energy level, it releases light. The light bounces back to the reflectors at each end. Stimulating more and more emission from the atoms inside the laser All the lights are of the same frequency and the waves are all perfectly in step.

Rationale Behind Construction of the Exhibit

These days Lasers are gaining more importance. Lasers are boon to mankind as they are used in a number of field like medical science, holography, optical communication etc. Here we are using Laser for communication. By using Laser Data is transferred in the form of Beam that is why it is safer to transmit data The main aim of construction of this project is to make communication more safe, secure, fast and reliable than other communication systems.

Materials Required

Two 741 operational amplifiers; DTMF generator UM91513; DTMF decoder CM8870; 7 segment display decoder I.C. 7447;

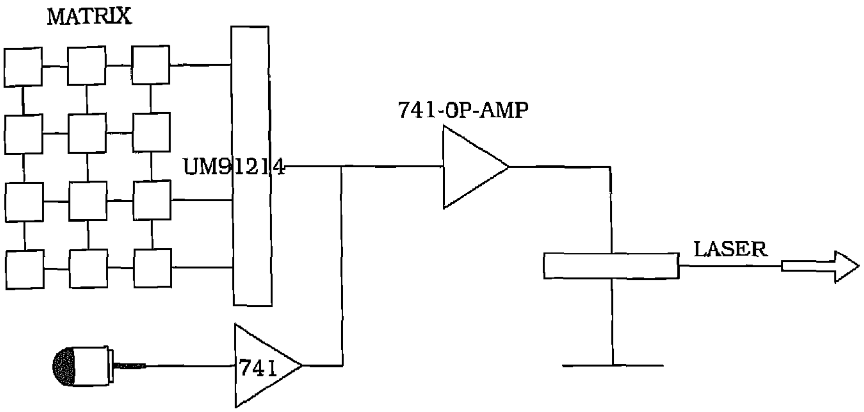


Fig. 16.1

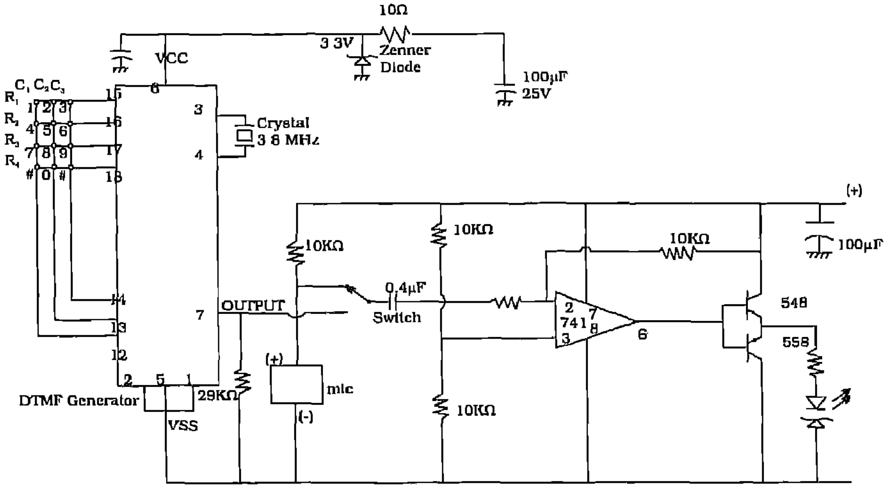


Fig. 16.2

Laser (semiconductor); crystal 3.8 MHz; Zener diode; 12 switches; pnp and npn transistors (548, 558); 14 resistance of 10k Ω and 6 of 100 k Ω; speaker of 8 W; and 7 segment display.

Laser Communication

Laser communication is the unique name in the field of communication. In this communication we transmit the data through the laser and we need not to use the carrier frequency for this project. This model is very useful for line-to-line communication. Data, signal is transferred from one end to other end with the help of laser light. Nobody catches this frequency.

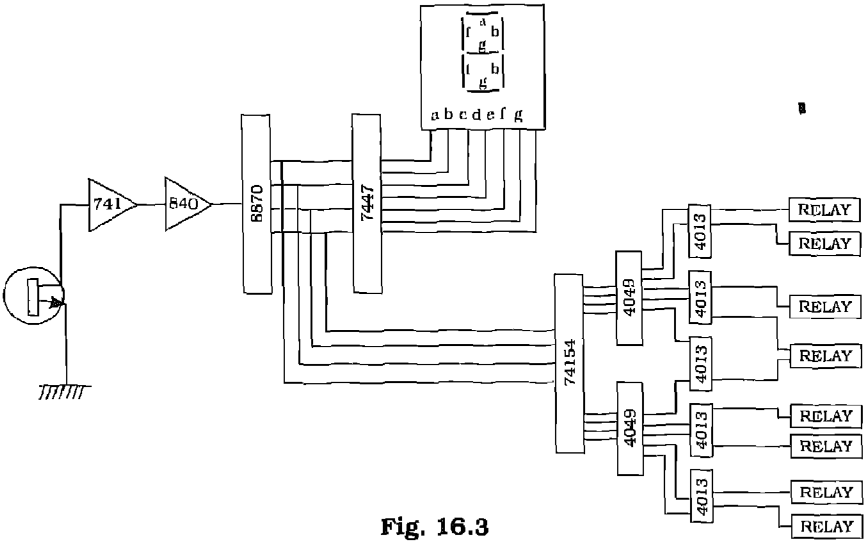


Fig. 16.3

So this is very useful to communicate the data between two ships, between two hills. When we use R F frequency to transfer the data, then any active person with active receiver, catches this frequency. But when we use laser communication then nobody traps the signal. In laser communication, we aim at two types of signals :

1. Recorded signal;
2. Signal from mike.

Here we transmit two signals one is recorded and second signal from mike. We use changeover switch to select the signals. SE feed data from mike, then mike convert the audio signal into electrical signal and this electrical signal is coupled to the pin no. 2 and I C. 741. Here we use I.C. 741 as a mike amplifier. Pin No. 7 is connected to the voltage at pin no 6 for further amplification we use transistor circuit. Output of transistor circuit is connected to the laser light. Actually second signal from transistor circuit is converted into light. Zener diode is used with laser light to protect them from high voltage DATA is now superimpose on the laser light and we focus this laser light on the receiver. In receiver section we use on photo sensor as a receiver part. When laser light focus on the photo sensor the photo sensor convert this light into voltage, this small voltage in the farm at signals is again fed to the pin no. 2 at I.C 741. Again amplified output available on pin no. 6 at I C 741 is further amplified by a transistor circuit.

Application

1. Transfer of confidential data and information especially for defence purposes where security of information is of utmost importance
2. By using this system communication in the country can be made much more safer so that no outsider or unwanted person can disturb or intervene in important communication

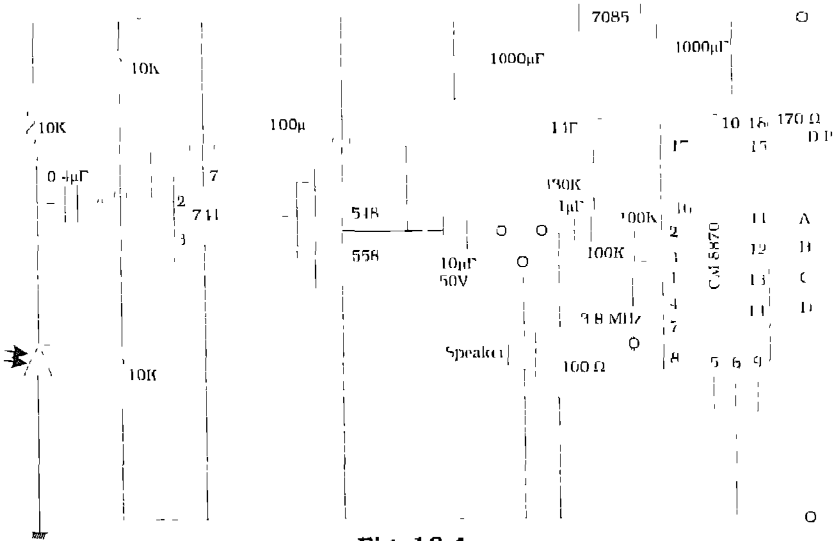


Fig. 16.4

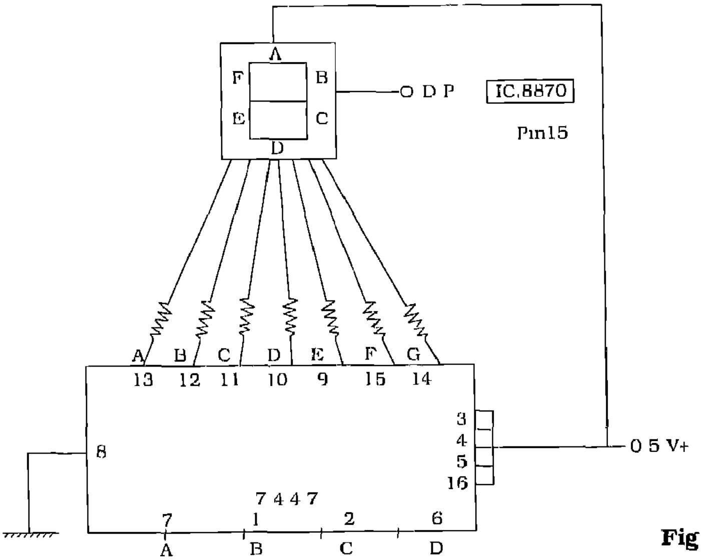


Fig. 16.5

17

Wino Solar Tech

Students : Rojana Tomang
Rinkila Bhutia
Binita Pradhan
Teacher : Prakash Rawat

Mangan Sr Sec School
North Sikkim 737 116

Introduction

In this model we demonstrate the working of a sun synchronised power plant and a vertical axis wind turbine The turbine rotates irrespective of the wind direction. Wind and Solar energies are the two potential non-conventional energy sources, that can solve the problem of ever shrinking fossil fuels In our model we have tried to overcome certain limitations in harnessing these non-conventional energy sources.

Materials Required

Two wooden wheels with ball bearings fitted at its centre, one steel plate of suitable size which is used as concave mirror in the model, plane mirror, dynamo (armature is made with a large number of turns of copper wire which is wound over a core of large iron nail. The armature is made capable of rotating in between magnets); an ammeter (to measure the produced current); a fan; water bucket, a long cuboidal vessel; aluminium foil, string, ball bearing, belt, wooden stand, gear etc.

Construction and Working

1. *Sun Synchoronised Power Plant :* Two wooden wheels fixed with ball bearing at its centre are fixed on wooden stands, which

are kept on a table The plane mirror (reflector) and the concave mirror are fixed on a vertical wooden stand fixed along the axis of the wooden wheels. Two mirrors move along with rotating wheels (Fig 17 1) The plane mirror faces the sun and the concave mirror faces the plane mirror To keep the reflecting plane mirror in alignment with the sun, the speed of rotation of the mirror is adjusted in such a way that reflector always faces the sun Strings are passed around the rim of the two wooden wheels. The ends of the string are passed around the rim of the two wooden wheels. The ends of the string are passed through pulleys. The ends of the strings are attached to wooden blocks, which are made to float in water kept in a cuboidal large vessel. The other ends of the strings are suspended with weights. A water cane fitted with tap is placed near the cuboidal vessel in which two wooden blocks are floating as shown in Fig. 17.1.

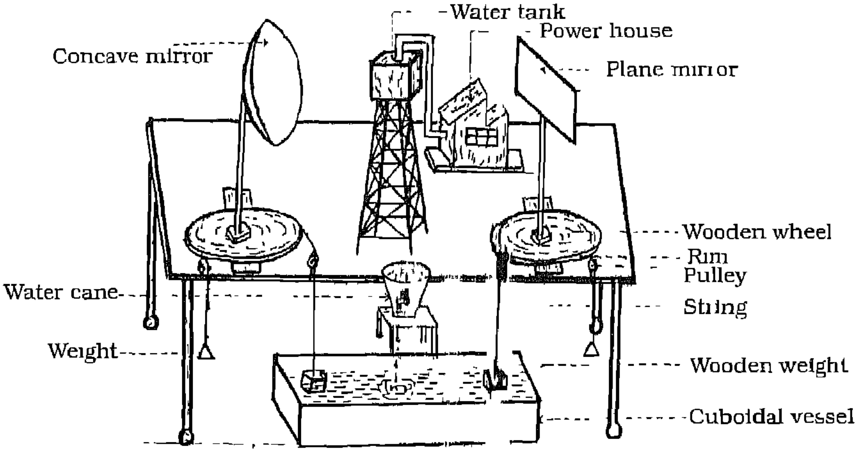


Fig. 17.1

On opening and allowing water to come out drop-by-drop, water falls in the cuboidal vessel The wooden blocks floating in water experiences an upward force due to buoyancy of water. The weights attached to other end of the string moves down due to force of gravity This movement of the string rotates the wooden wheel as well as mirrors fixed on it, one in clockwise direction and the other in anti-clockwise direction The speed of flow of water can be so adjusted that the reflector rotates with the same speed as the apparent position the sun changes in the sky. Thus reflector always faces the sun and the concave mirror The concave mirror converges the sun rays at its focal point where the tank is placed. The heat will be sufficient to warm the water inside the tank. The steam generated by the water tank will be enough to rotate the turbine of the generator to produce electricity.

2. *Wind Power Plant* Vertical axis wind turbine is made as shown in the Fig.17.2. The blades are made with aluminium foil, which are fixed in a vertical shaft. The vertical shaft is fixed on a wooden stand with a ball bearing at its centre. The shaft is connected to the main shaft of the armature of dynamo. The wind turbine is rotated by the effect of the wind pressure. (In our model we have used an electric fan to generate wind artificially) As the wind turbine rotates the armature also rotates, which is connected with the turbine shaft with a rubber belt. When the armature rotates in between the magnets, the magnetic flux linked with it changes. Due to the continuous rotation of the armature, an e.m.f. is induced.

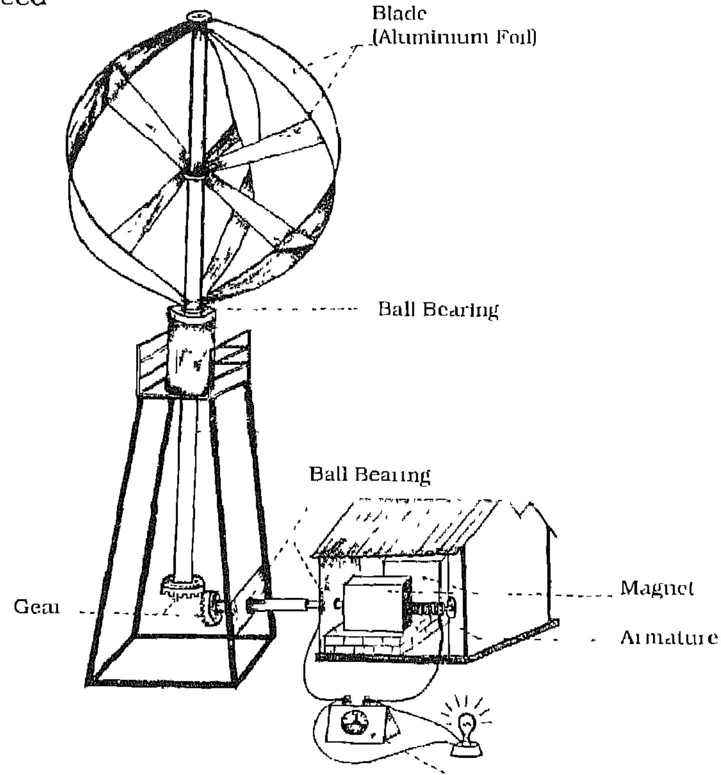


Fig. 17.2

18

A Network of Models

Students Anita Kumari Ghanshyam Balika H S Khagaul
Vinita Kumari Patna, (Bihar)
Alka Kumari
Teacher Dr Kameshwar Singh

Introduction

The idea of preparing this set of models was conceived while observing traffic signaling and a railway coach catching fire due to short circuit or other reasons. Furthermore a car is lifted without any noise. These observations prompted us to prepare a network of models for (1) Automatic light signaling, (2) Automatic fire alarm in cars and trains, and (3) Touch alarm.

AUTOMATIC FIRE ALARM

Introduction

This exhibit helps us to give prior information about fire in car engines or train coaches This helps us to protect the lives of people travelling in railway coaches or car by taking proper safeguard measures.

Principle

This exhibit is based on heating effect of bimetallic strips. Plates of two different metals having greater difference in the coefficients of linear expansion are riveted together at a number of points in such a way that they cannot slide on being heated or cooled, form a bimetallic strip When the strip is heated the brass expands more as compared to invar This unequal expansion curves strips such that brass takes the outer edge of the curve and the invar the inner edge. The greater the difference in the coefficients of linear expansions of metals more is the bending of strip for a given rise or fall in temperature thus bimetallic strip becomes more sensitive to change in temperature.

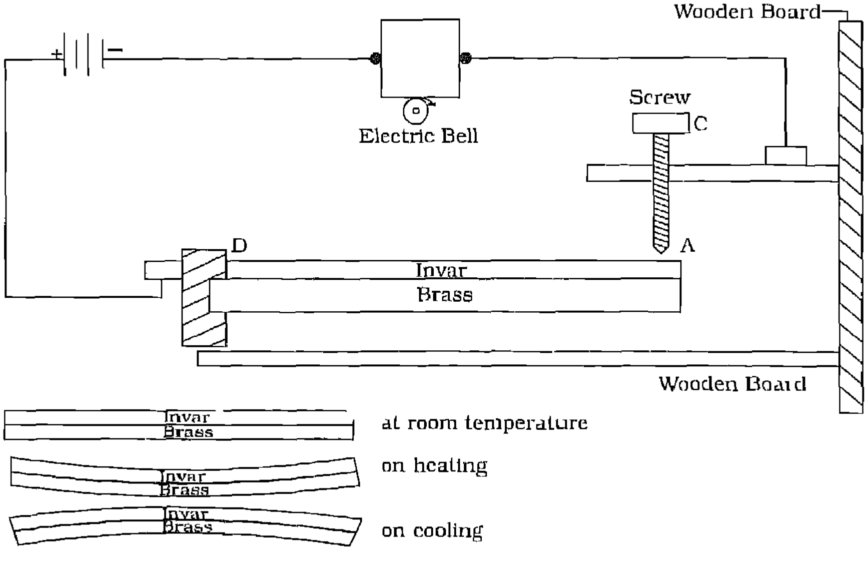


Fig. 18.1

Materials Required

Bimetallic strips (brass and invar); electrical bell; heater or lamps; wooden frames.

Construction

An invar-brass bimetallic strip is fixed on a wooden board, such that its one end is fixed, but the other end is free and just below a movable screw made of brass. Electrical connections are provided as shown in the diagram on plane paper sheet (model no.1).

Working

In case of fire, one end of the bimetallic strip rises upward, as brass expands more than Invar. When the other end touches contact screw C electric circuit is completed and hence bell starts ringing.

Application

It can be applied in vehicles and trains coaches to monitor the information of fire due to short circuit or over-heating or other reasons

TOUCH ALARM

Introduction

In this exhibit a wonderful device has been constructed in which bell rings as soon as the body of a vehicle is touched. It helps us to provide security against car lifters

Principle

This exhibit works on electronic circuit It involves the principle of resistances, transistors and audio oscillators

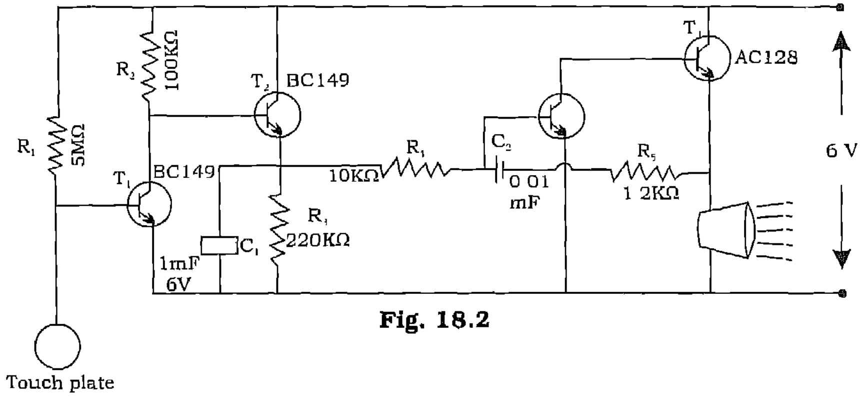


Fig. 18.2

Materials Required

A plastic lunch box; a P.C. board; four transistors TI-BC 149, T2-BC 149, T3-BC 147 and T4-AC 128, 5 resistances R1-5 M ohm, R2-100 kilo ohm, R3-220 kilo ohm, R4-10 kilo ohm and R5-1.2 kilo ohm; two capacitors C1-1 microfarad, 6 volt, C2-0 01 microfarad (disc ceramic); loud speaker 80 ohm, 500 miliwatt; a copper plate used as contact plate; copper wire and soldering wire; 4 dry cells

Construction

All the connections are completed on the P.C B. The P C B. is placed in the Lunch-box The four cells are connected as shown in the diagram 2. As soon as the torch is touched, a strange. Sound is heard

Working

This circuit functions in two stages which are mentioned here:

Stage 1 · Two transistors T1 and T2 complete the trigger circuits, when the copper plate is touched, transistor T1 functions as a Conductor and is amplified by resonance transistor T2.

Stage 2 : In this circuit, a circuit of audio oscillators is formed by transistors T3 and T4. Here signal coming from stage-1 of trigger is changed into audio signal which is transformed into sound by the loudspeaker.

Application

It can provide safeguard against car lifting Anyone touches the body of the vehicle, alarms the owner of the car

AUTOMATIC TRAFFIC LIGHT SIGNALING.

Introduction

In cities to control traffic movements and in railways network to control smooth movement of trains and to check inherent accident, automatic traffic lights and height signaling for trains are utilised.

Materials Required

Two cardboards rectangular in size, a red, a green and a yellow bulbs of 3 volts each; 3 holders; 2 cells, 4 drawing pins, a U-clip.

Construction

Two cardboards are arranged at right angles with the help of screws. The three holders are arranged in a row, and are connected in parallel series Bulbs are fitted in the holders The red bulb is fitted on the top and the green bulb at the bottom of the board. The three wires are connected to the three drawing pins A.C. or two dry cells.

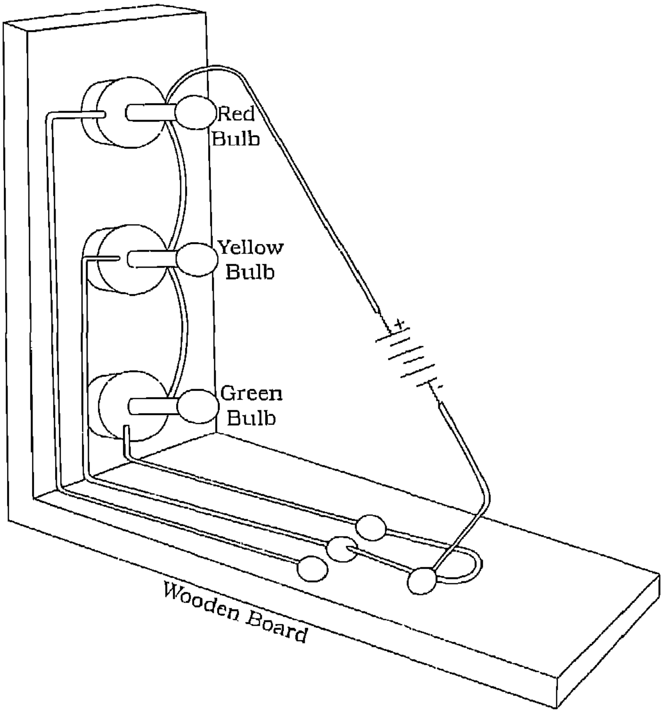


Fig. 18.3

Operation

As soon as the U-clip touches the drawing pin, the desired bulb is lighted.

Application

1 To control the movement of trains or vehicles.
2. To control and avoid accidents

19

Internal Combustion Engine

Student Tejas Talak
Teacher Jennifer Pereira

Mahila and Nutan English
High School, Comba
Margao, Goa

Introduction

An internal combustion engine is an engine in which combustion of fuel is carried out inside its cylinder This model describes the functioning of four strokes used in a petrol engine.

Materials Required

Thermocol sheets and fillings, spark plug; cell and switch

Working

In a petrol engine, mixture of petrol vapours and air is compressed and ignited with the help of a spark plug. The hot gases produced inside the cylinder push the piston of the cylinder outwards. The to-and-fro motion of the piston is converted into rotational motion of the wheels with the help of a crank-shaft (Fig.19 1) The waste gases are pushed out through the exhaust and the cycle restarts. The four strokes are described below:

(i) *First stroke (charging stroke)* : In this stroke, a mixture of fuel (petrol) and air enters into the cylinder.
(ii) *Second stroke (compression stroke)* : In this stroke, fuel and air mixture is compressed.
(iii) *Third stroke (Ignition or working stroke)* : At the beginning of this stroke, the fuel and air mixture is ignited by an electric

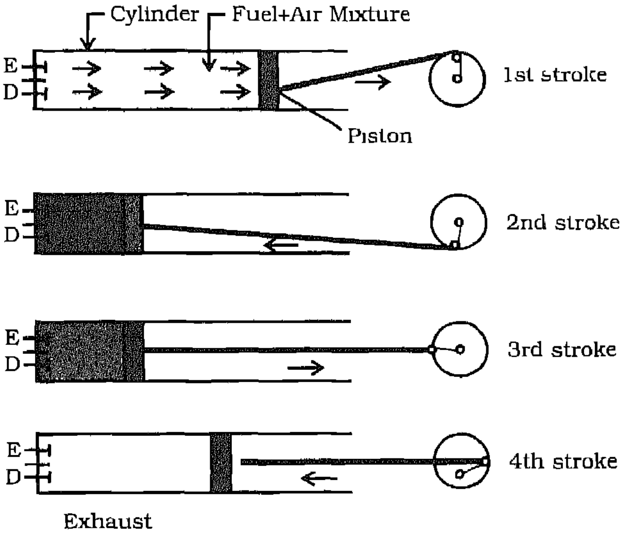


Fig. 19.1

spark (from the spark plug), and the explosion occurs. This causes outward motion of the piston due to the expansive action of the gases. This movement of the piston then rotates the wheels.

(iv) *Fourth stroke :* The piston moves inwards and the residue gases are forced out of the cylinder through the exhaust valve.

20

Nalgonda Technique for Defluoridation of Water

Students Patel Pratik Bakul Bhai M P Pandya High School
Patel Pragnesh Maheshbhai Jatalpur, Tadasaroi
Teacher Patel Jethabhai Mangaldas Distt Ahmedabad
Gujarat

Introduction

Excess of fluorides in drinking water may lead to several orthopaedic and density problems in human beings Twelve states of India, including Gujarat, are facing the problem of fluoride salts in drinking water The proposed technique, called Nalgonda Technique after the name of village in Andhra Pradesh, where it was demonstrated first, is a combination of several units described below

Scientific Principle

This technique is a combination of following

(i) Rapid mixing of alkali, aluminium salts and bleaching powder with water. During this the fluoride salts present in water interact chemically with aluminium salts

(ii) A gentle agitation of mixture is made by using flocculation technique. The agitated water is then sent to sedimentation tank for settling the fluorides, turbidity, bacterial and other impurities.

(iii) Filtration of mixture for reducing the concentration of suspended solids.

(iv) Chloronisation by bleaching powder.

Materials Required

Acrylic plastic cylinder of different sizes, plastic lids, iron strips, soft rubber, spond's reagent, alum and lime solutions, bleaching powder, a stirring motor, a water pump, an eliminator, glass ware and some stone pebbles.

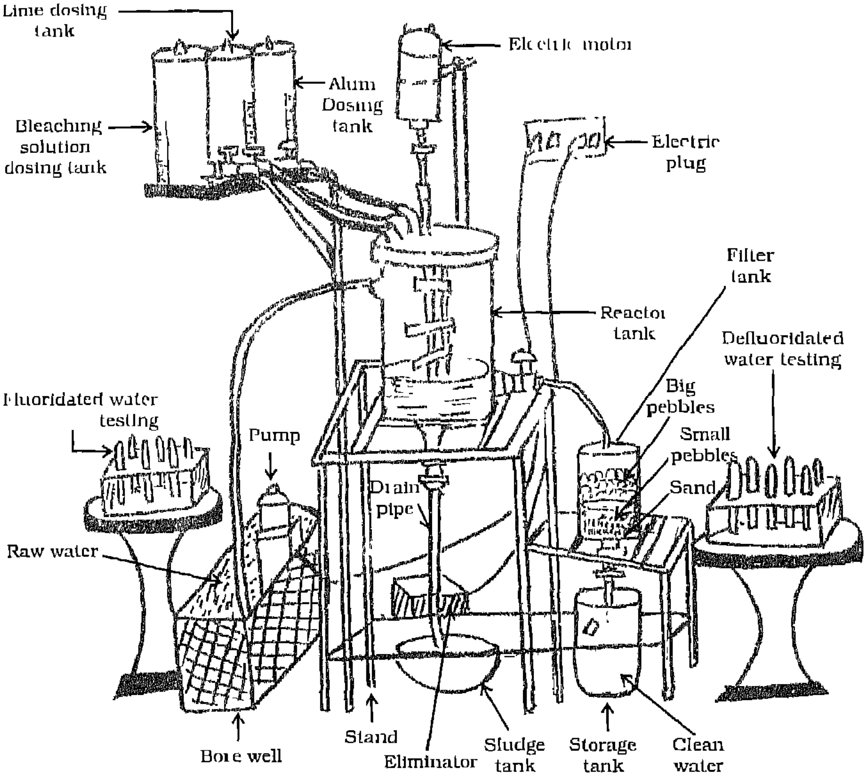


Fig. 20.1

Construction

Cylindrical tanks are made to set on or suitable stand. Reactor tank is joined with the fluoridated water pipes. The topmost part of the reactor tank is joined with alum dosing tank, lime dosing tank and bleaching solution dosing tank as shown in Fig.20 1. Stirrer with stirring blades at the bottom end is being set for churning the water A valve connected with the drainpipe is set at the bottom of the reactor The other end of the drainpipe goes into the sludge tank, which is kept below the drainpipe. Reactor tank and filter tank are joined by the clean water pipe. Three layers of big pebbles, small pebbles and sand are placed in the filter. Storage water tank is placed below the filter tank. Water testing tables have been set for testing the supplied bore-well and filtered water separately (see Fig. 20.1 for detailed structure).

Working

This model is divided into three parts according to their functions.

A. *Demonstration of Fluoridated Water :* We have used spond's reagent for determining the proportion of fluorides in the water. The original bore-well water is tested and if the fluorides exceeds the permissible level then the colour of the water looks dim red-orange

B. *Defluoridation and Filtration* Water supplied in the reactor is the mixture of water and added salts. Lime salt and bleaching powder are added from the tanks. Solution of bleaching powder is added in proportion of 3 mg per litre. The mixture is stirred to make it uniform. Suitable quantity of alum is also added to remove fluorides from water The chemical reaction taking place (not balanced) is·

$$\underset{\text{Alum solution}}{Al_2(SO_4)_3 18H_2O} + NaF + Na_2CO_3 \rightarrow \underset{\substack{\downarrow \\ \text{Aluminium} \\ \text{Fluoride salt (Floc)}}}{Al(OH)\ Al(OH)_2F} + Na_2SO_4 + NaHCO_3 + CO_2 + H_2O$$

In this process, reaction of hybridisation of aluminium takes place Alum is transformed into transient alumenic species, which mixes with fluoride ions and absorbed into the aluminum hydroxide (Floc.). Lime solution changes alkaline flocs into denser flocs, which helps the purification process. Bleaching solution destroys bacteria lying in water reactor tank. (This also works in flocculation tank as well as sedimentation tank.). Sludge settles at the bottom within short duration depending upon the size of reactor tank. Thereafter the floating water is brought into the filter tank through the valve. During filtration, insoluble impurities are removed from water and pure defluoridated drinking water is obtained. The sludge may be sent to sludge tank using the sludge valve.

C. *Test of Defluoridated Water :* Proportion of fluoride salts in water is essential from 0.8 mg/L to 1 mg/L. The defluoridated water is tested by spond's reagent again Two drops of spond's reagent are dropped into the test tube filled with water. A dark red or orange colour of water ensures the satisfactory level of fluorides in water.

21

Electro-Magnetic Crane

Student Anish Kumar Kar
Teacher · D P Mishra

Demonstration Multipurpose
School, Regional Institute
of Education, Bhubaneshwar

Introduction

A magnetic crane works on the principle of electromagnetism. Giant cranes are used to move heavy iron masses and the steel scrap from one place to another with the help of motors. This project describes how to make an advanced model of magnetic crane with the help of electric motor.

Materials Required

Enameled copper wire about 6 meters long; a shoebox, two pieces of thick copper wires, one 6 centimeters long cork; three U-Clips, one cotton reel; string; two-6V battery; two long bar magnet; scissors, iron bolts, tape; four nails; drawing pins, and one iron knitting needle

Working

An electric motor works on the principle of electromagnetic induction An electric current flows into the motor through a wire The wire inside an electric motor is wound into a coil that can rotate. The coil of wire is placed between two poles of a fixed bar magnet.

When an electric current flows through the wire, it creates a magnetic field around the coil, with a north pole at one side and

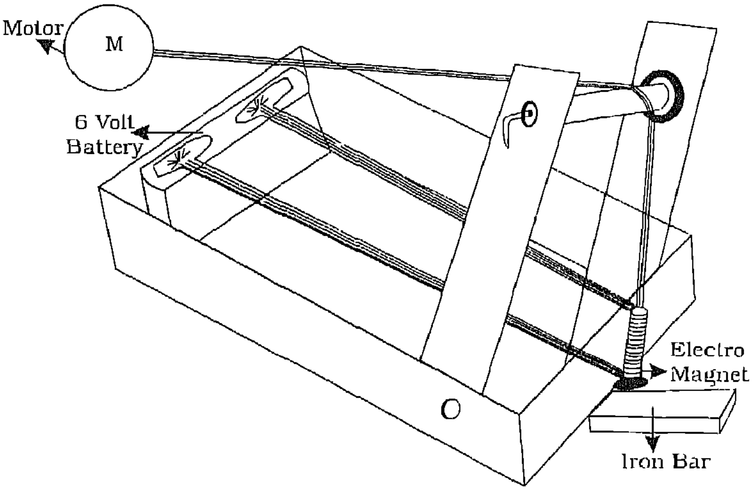


Fig. 21.1

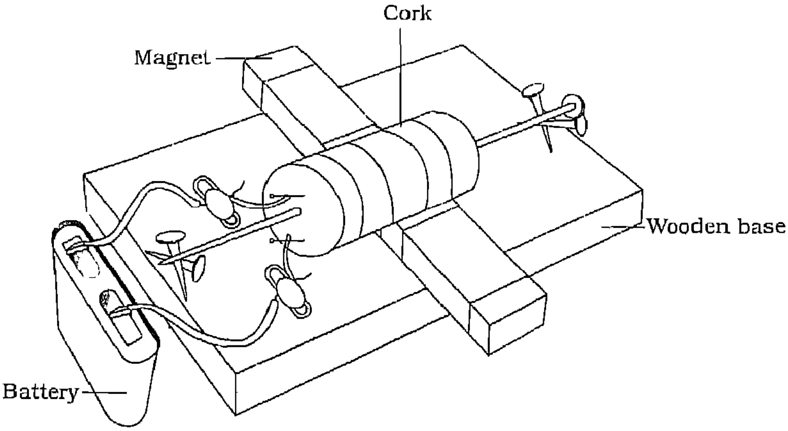


Fig. 21.2

South Pole on the other If the south pole of the coil is near the south pole of the fixed magnet two like poles repel each other and coils turns round. The coil rotates half way round the coil. In this way the motor works.

22

गति अवरोधकों से विद्युत उत्पादन

छात्र · विकास तिवारी
शिक्षक : एस.पी. दूबे

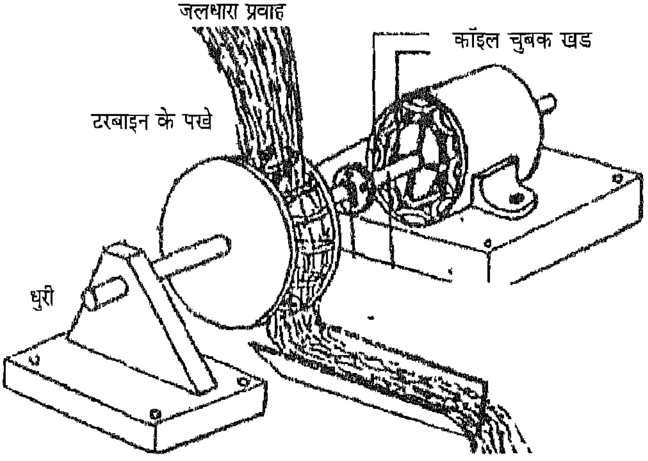
नगर पालिका उच्चतर माध्यमिक विद्यालय,
अबिकापुर, सरगुजा, छत्तीसगढ़

उद्देश्य

पुलो पर स्थित गति अवरोधकों के द्वारा विद्युत उत्पादन करना।

प्रक्रिया

यह दाब पर आधारित एक ऐसी युक्ति (उपकरण) है जो पास्कल के नियमों का पालन करती है। चित्रानुसार उपकरण सयोजित करते है, पुल जिसके नीचे से नदी प्रवाहित होती रहती है, उसके नीचे एक टकी लगी होती है, जिसमे दो वाल्व लगे होते है। पहला वाल्व (Water in) लगा होता है जिसमे से होकर पानी एक निश्चित सतह तक उपर



चित्र 22.1

आने लगता है। दूसरा वाल्व (Water out) लगा होता है। जैसे ही पुल पर बने ब्रेकर पर दाब आरोपित (वाहन द्वारा) किया जाता है तो दाब के कारण टकी मे भरा पानी (Water out) से प्रेशर के साथ बाहर निकलता है, इस Water को एक निश्चित दूरी तथा प्रेशर टरबाइन पर गिराया जाता है, तो पानी की स्थितिज ऊर्जा मोटर द्वारा विद्युत ऊर्जा मे परिवर्तित हो जाती है। उत्पन्न विद्युत को विद्युत संग्राहक कक्ष में एकत्रित कर ट्रांसफार्मर द्वारा दूर-दराज तक वितरित कर सकते है। तत्पश्चात् जैसे ही वाहन ब्रेकर पर से होकर गुजर जाता है तो ब्रेकर अपनी पूर्वावस्था में आ जाता है, तो पुन: टकी में पानी आ जाता है और यह प्रक्रम लगातार चलता रहता है।

कुछ ध्यान देने योग्य बातें

1. इसका उपयोग अधिक ट्रैफिक वाले बड़े शहरो मे किया जाना चाहिए।
2 टंकी मे से Water का प्रवाह Water out के अलावा कहीं से नहीं होना चाहिए।
3. Water in की सतह (पाइप) हमेशा पानी में डूबी रहनी चाहिए।

विशेषता

1. इसके द्वारा प्राप्त विद्युत को ट्रांसफार्मर द्वारा वितरित कर बिजली की पूर्ति की जा सकती है।
2. कम खर्च में इसको उपयोग में लाया जा सकता है।
3. जल विद्युत उत्पादन के पश्चात् टरबाइन के ऊपर आए पानी का उपयोग खेतों की सिचाई में किया जा सकता है।
4. ब्रेकर के द्वारा वाहन की संभावित दुर्घटनाओं से सुरक्षा प्राप्त की जा सकती है।

जल विद्युत उत्पादन

विद्युत के बड़े पैमाने पर उत्पादन ने औद्योगिक एव तकनीकी विकास की गति को बहुत तीव्र कर दिया है। बड़े पैमाने पर विद्युत ऊर्जा उत्पन्न करने के लिए प्रयुक्त यत्र के दो प्रमुख अग हैं —

1. टरबाइन
2 जेनरेटर

जेनरेटर के दो भाग होते हैं एक स्थिर रहता है जिसे स्टेटर (Stator) कहते है। दूसरा एक धुरी पर घूर्णन करता है जिसे रोटर (Rotor) कहते है। रोटर की धुरी टरबाइन की धुरी से सयुक्त रहती है। घूर्णन करने वाली धुरी पर शक्तिशाली चुबक के अनेक

टुकड़े संगलित कर रोटर बनाया जाता है। एक खोखले बेलन के अंदर कई कुंडलियों में स्टेटर बनाया जाता है।

रोटर की धुरी व टरबाइन की धुरी एक-दूसरे से दृढ़ता के साथ जुड़े रहते हैं। नदियों मे बहते हुए जल की ऊर्जा परपरागत रूप से जल चक्कियो के पाटो को घुमाने मे उपयोग की जाती है। आज भी हमारे देश के दूर-दराज के पहाड़ी क्षेत्रों मे इस प्रकार की जल चक्कियाँ देखी जा सकती हैं।

जल ऊर्जा को उपयोग करने की अधिक दक्ष एव सरल विधि है – उसे विद्युत ऊर्जा में परिवर्तित कर देना। इस प्रक्रिया के विभिन्न चरण आपको भलीभाति ज्ञात है। नदियों में बहते हुए पानी को बांध की सहायता से संग्रह कर लिया जाता है। अब बाध के उच्च स्तर से जल को पाइपो द्वारा उसके तली के पास लगाए विद्युत जनित्र तक गिराया जाता है। इस प्रक्रम मे जल की स्थितिज ऊर्जा गिरते पानी की गतिज ऊर्जा में परिवर्तित हो जाती है। पाइप से गिरता हुआ पानी टरबाइनों को घुमाता है जो विद्युत जनित्रो के आर्मेचर को घुमाती है और इस प्रकार विद्युत उत्पन्न होती है।

जल विद्युत, वर्तमान समय में, हमारे देश मे उत्पन्न कुल शक्ति का लगभग 23 प्रतिशत से कुछ अधिक का योगदान करती है। भारत मे जल विद्युत की कुल क्षमता लगभग 400×10^9 किलोवाट घंटा मापी गई है।

जल विद्युत शक्ति द्वारा ऊर्जा उत्पन्न करने में प्रदूषण नहीं होता और यह ऊर्जा का नवीकरणीय स्रोत भी है, फिर भी इस स्रोत के दोहन मे पर्यावरण सबंधी अनेक समस्याएं जुड़ी हैं। किसी नदी में बांध बनाने के परिणामस्वरूप उस नदी के अनुप्रवाह क्षेत्र मे पारिस्थितिक सबंधी अनेक समस्याएं उत्पन्न हो सकती हैं।

आज के विद्युत खपत को देखते हुए हर साधन से विद्युत उत्पादन करने के उपाय किए जा रहे हैं।

23

मैनुअल वाटर पंप

छात्रा : रिकू सिंह
निशि उपाध्याय
शिक्षक : रामेश्वर स्वरूप वर्मा

डा. नेमिचद शास्त्री कन्या उच्च
विद्यालय आरा, भोजपुर
बिहार

प्रस्तावना

भारत की जनसंख्या 70 प्रतिशत से भी अधिक गांवो मे रहती है। बहुत सारे गांवो मे अभी भी विद्युत नही पहुँची है। इसलिए हमे विद्युत के विकल्प को ध्यान मे रखते हुए गांव मे सिंचाई की व्यवस्था के बारे मे सोचना चाहिए। इसी बात को ध्यान मे रखकर यह प्रदर्श तैयार किया गया है। समतल खेतो से लेकर पहाड़ी इलाकों मे भी खेतो की सिंचाई की जा सकती है। जल का स्तर गर्मी के दिनो मे नीचे चला जाता है। उस समय भी मैनुअल वाटर पंप काम करता है।

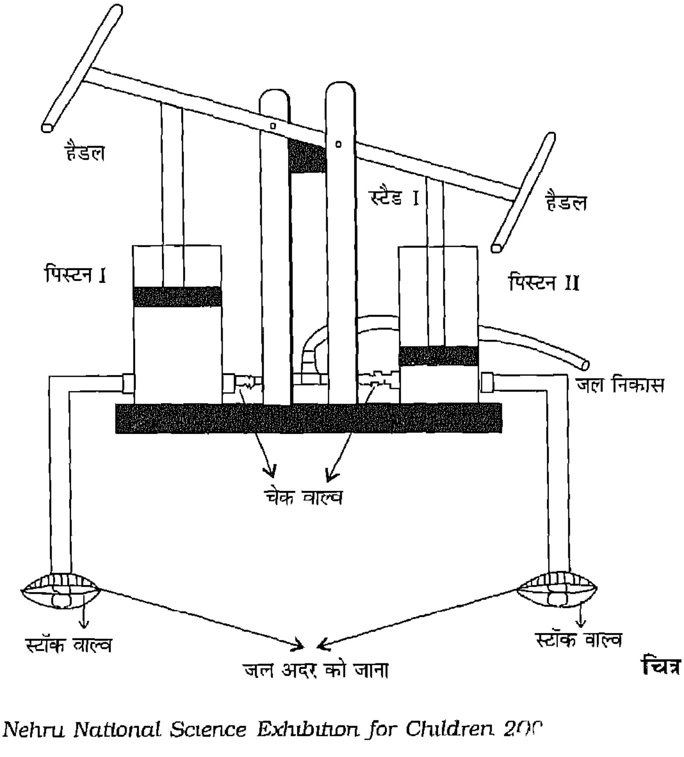
बनावट

इसके लिए टिन के चद्दरों के दो खोखले बेलनाकार बर्तन बराबर आकार के बनाए जाते हैं जिसका एक मुँह खुला और दूसरा बंद रहता है। दोनो बर्तनो मे एक लकडी का पिस्टन होता है जिसके नीचे वाले छोर मे रबर के मोटे वाशर लगे होते हैं जो बेलनाकार बर्तन में कसकर ऊपर-नीचे आते और जाते हैं। बेलनाकार बर्तन के पेदे के ऊपर दोनों ओर लोहे के चार-चार इच के पाइप जिनका व्यास आधा इंच होता है लगे होते है। बैरल का पानी प्रवेश न करे इसके लिए दोनों बैरलों के बीच में दो चेक वाल्व लगे रहते हैं। दोनों बैरल के दूसरे पाइप में आवश्यकतानुसार एक-एक आधा इंच के व्यास के बराबर लंबाई के दो पाइप जुड़े रहते हैं जिनके नीचे वाले छोरों में एक-एक स्टॉक वाल्व जुडा होता है।

लीवरनुमा एक लकड़ी के छोरो को दोनो पिस्टन के ऊपरी छोरो से जोड़ दिया जाता है। यह लकडी का हैंडल पिस्टन के ऊपर-नीचे खिंचने का काम करता है। जब एक पिस्टन को नीचे दबाया जाता है तब दूसरा पिस्टन अपने-आप ऊपर खिंच जाता है। इस तरह से पानी को हम ऊपर खीचकर रबर के पाइप द्वारा जरूरतमंद खेतो तक पहुँचा देते है। इस पप की दुगुनी शक्ति द्वारा हम बहुत आसानी से अपने पानी की माँग को पूरा कर सकते है।

उपयोगिता

1. यह गांव में रहने वाले लोगों के लिए बहुत लाभदायक है।
2. इसकी लागत बहुत कम है और इसे एक आदमी आसानी से ढोकर एक स्थान से दूसरे स्थान तक ले जा सकता है। साथ ही खराब हो जाने पर इसकी मरम्मत करना भी बहुत आसान है।
3. समतल मैदानो के खेतो को इस प्रदर्श द्वारा आसानी से पटाया जा सकता है। जल का स्तर नीचे जाने पर भी पानी को वहां से खीचकर खेतों को पहुँचा देता है।
4. पहाड़ी इलाकों के खेतो की भी इस पप के द्वारा सिंचाई की जा सकती है।



चित्र 23.1

24

धूम्र अवक्षेपण यंत्र

छात्र : विनय व्यास
शिक्षक : बीरबल सिह

राजकीय उच्चतर माध्यमिक विद्यालय
भीनमाल, जिला जालौर (राजस्थान)

प्रस्तावना

विश्व की निरंतर बढ़ती आबादी तथा विज्ञान के नित नए आविष्कारो के उपयोग से हमारा पर्यावरण प्रदूषित हो रहा है। वायु-प्रदूषण से हमारी श्वसन प्रक्रिया प्रभावित होती है तथा सास्कृतिक धरोहरों का क्षय हो रहा है। वायु-प्रदूषण को कम करने के लिए प्रस्तुत प्रदर्श, 'धूम्र अवक्षेपण यंत्र' को कल-कारखानों, फैक्ट्रियो आदि की चिमनियो पर लगाकर धुए में से विषैले कणों को दूर किया जा सकता है।

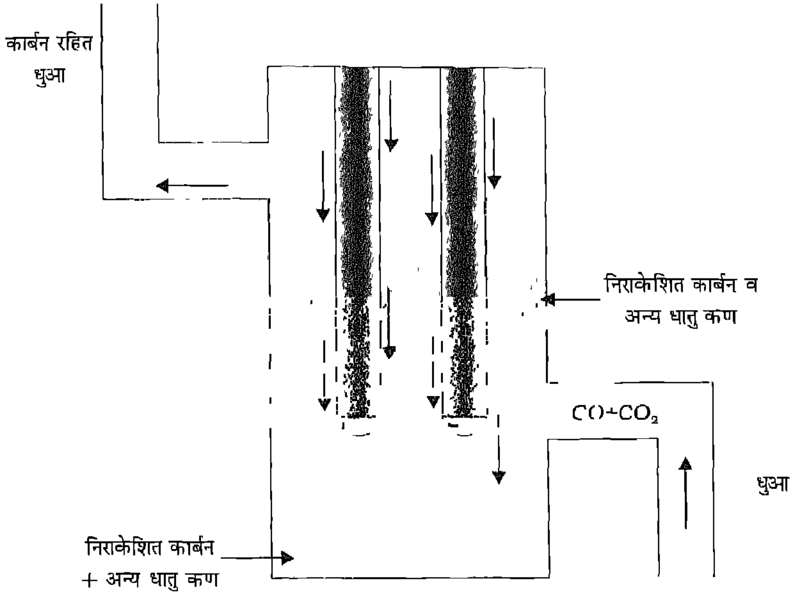
प्रयुक्त सामग्री

प्लाइवुड, कार्बन व जस्ते की छड़, विद्युत तार आदि।

संरचना एवं कार्य प्रणाली

फैक्ट्रियो में ईधन के रूप में कोयला, पेट्रो-पदार्थ आदि प्रयुक्त होते है, जिनके जलने पर विषैला धुआं बनता है। इस धुए में जहरीली गैसें जैसे CO, CO_2 तथा धातु आदि मिले होते हैं जो कि वायु-प्रदूषण को बढ़ाते है।

धूम्र अवक्षेपण (जिनकी सरचना चित्र 24.1 में दर्शायी गई है) द्वारा धुएँ मे मिले कार्बन कण तथा वात्य भट्टी से निकली बारीक धातु कणों का अवशोषण किया जाता है। इस यंत्र को फैक्ट्री की चिमनी पर लगा सकते हैं। इस यत्र में कार्बन की छड़ एनोड (धनावेश) तथा जस्ते की छड़ कैथोड (ऋणावेश) का कार्य करती है। जब धुआ इस


कार्बन रहित धुआ
निराकेशित कार्बन व अन्य धातु कण
$CO+CO_2$
धुआ
निराकेशित कार्बन + अन्य धातु कण

चित्र 24.1

यत्र में से प्रवाहित होता है, धुएं में मिले कार्बन कण ऋणावेशित होते है, जो कि एनोड की ओर आकर्षित हो जाते है, तब ये कण कोलायडी अवस्था मे आकर निरावेशित हो जाते हैं। इसी प्रकार वात्य भट्टी से निकले बारीक धातु कण जो कि धनावेशित होते है, कैथोड की ओर आकर्षित होकर चिपक जाते हैं। ये कण भी इसी प्रकार कोलायडी अवस्था मे आकर निरावेशित हो जाते हैं। इस सपूर्ण प्रक्रिया को कोलायडीकरण कहते है।

इससे ये अशुद्धियाँ निरावेशित होकर यंत्र के पैंदे में इकट्ठी हो जाती है, जिन्हे पृथक् किया जाता है। शेष धुआं यत्र से निष्कासित हो जाता है। इस यत्र के उपयोग से निम्न कार्य हो सकते हैं :

1. मूल्यवान बारीक धातु कणो को पुनः प्राप्त किया जाता है। कार्बन कणो को एकत्र कर उनका उपयोग अन्य वस्तुएँ बनाने में किया जा सकता है।
2. कार्बन कण वातावरण में नहीं मिलने के कारण वायु-प्रदूषण नहीं होता।
3. कार्बन कण जब बादलो के संपर्क मे नहीं आएगे तो अम्लीय वर्षा होने का कोई खतरा नहीं होगा।
4. धुए के शुद्धिकरण से ओजोन परत में छेद नही होंगे।
5. वायु प्रदूषण से प्रदत्त रोगो में कमी भी इस यंत्र के माध्यम से होती है।

25

विद्युत धारा के प्रभाव एवं उपयोग

छात्र: विजय सिह कुशवाहा
शिक्षक : राजेश कुमार गौतम

तिलक बाल मंदिर माध्यमिक विद्यालय
कोटा रोड, बारा (राजस्थान)

प्रस्तावना

प्रौद्योगिकी युग मे भौतिक एव रसायन विज्ञान सबधी कुछ कठिन संप्रत्यो को मॉडल की सहायता से आसानी से समझा जा सकता है। प्रस्तुत प्रदर्श मे विद्युत ऊर्जा द्वारा उत्पन्न विभिन्न प्रभावों को प्रदर्शित किया गया है साथ ही इन प्रभावो के उपयोग भी दर्शाए गए हैं।

सिद्धांत

1. *विद्युत धारा का प्रकाशीय प्रभाव* : जब सुचालक में विद्युत धारा प्रवाहित की जाती है तो वह लाल तप्त होकर प्रकाश देने लगता है।
2. *विद्युत धारा का तापीय प्रभाव* : जब किसी तापन ततु मे विद्युत धारा प्रवाहित की जाती है तो वह कुंडली गर्म हो जाती है।
3. *विद्युत धारा का यांत्रिक प्रभाव* : जब आर्मेचर मे विद्युत धरा प्रवाहित की जाती है तो इसमें गति होने लगती है।
4. *विद्युत धारा का चुंबकीय प्रभाव* : जब लोहे की छड़ (कील) पर ताबे का विद्युत रूद्ध तार लपेट कर विद्युत धारा प्रवाहित की जाती है तो लोहे की छड़ चुंबक की तरह कार्य करने लगती है।
5. *विद्युत धारा का रासायनिक प्रभाव* : जब धातु के लवण (जैसे नीला थोथा) के जलीय विलयन मे दो इलेक्ट्रोड (एनोड एवं कैथोड) रखकर विद्युत धारा प्रवाहित की जाती है तो धातु के लवण का विद्युत अपघटन हो जाता है।

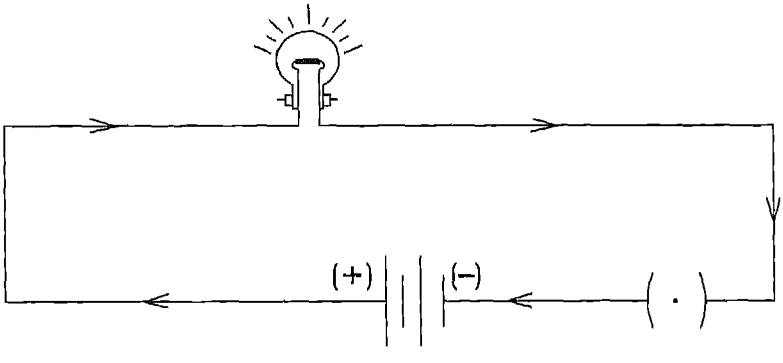
प्रयुक्त सामग्री

सुचालक तार, बैटरी, कुंजी (स्विच), लकड़ी की प्लाई, टेप, प्लग, होल्डर, बल्ब, हीटर, प्लेट, नाइक्रोम की कुडली, यात्रिक गति करने वाली वस्तुएँ (घटी, पखा), लोहे की लंबी कील, आलपिन, बीकर, नीले थोथे का जलीय विलयन, तांबे की छड़, लेपन करने वाली वस्तु।

संरचना एवं कार्यप्रणाली

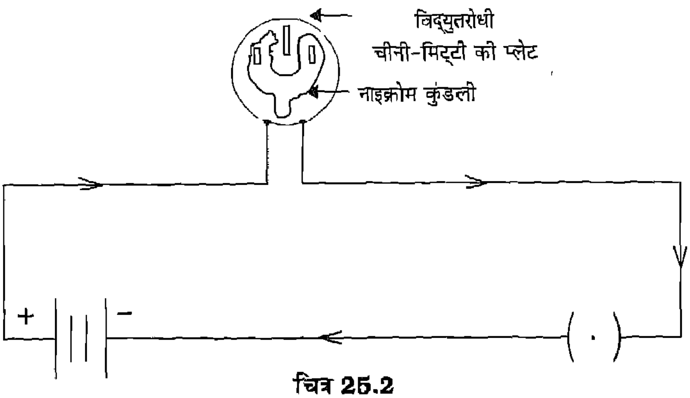
प्रदर्श की सरचना एवं कार्य प्रणाली को चरणबद्ध रूप मे समझा जा सकता है।

1. *विद्युत धारा का प्रकाशीय प्रभाव* : विद्युत परिपथ (चित्र 25.1) के लिए विद्युत स्रोत को कुजी के माध्यम से प्रकाश के स्रोत (बल्ब) से जोड़ते हैं। जब कुजी को लगाया जाता है तब बल्ब मे उपस्थित टगस्टन फिलामेट (जिसका उच्च प्रतिरोध एव उच्च गलनाक होता है) बिना पिघले लाल तप्त होकर प्रकाश देने लगता है। इस परिघटना का उपयोग विद्युत बल्बो मे किया जाता है।



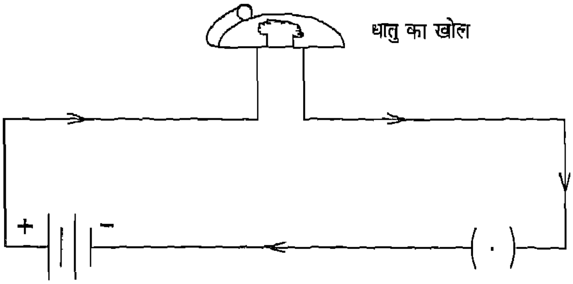
चित्र 25.1

2. *विद्युत धारा का तापीय प्रभाव* : विद्युत परिपथ (चित्र 25.2) के लिए विद्युत स्रोत को कुजी के माध्यम से जोड़ते हैं। जब कुंजी को दबाया जाता है तो विद्युत हीटर की कुंडली में जो साधरणतया नाइक्रोम मिश्रधातु (निकेल, क्रोमियम) की बनी होती है, मे धारा बहने पर इलेक्ट्रान के प्रवाह में अधिक बाधा पड़ती है तथा इस कारण कुंडली गर्म हो जाती है। इस परिपथ का उपयोग विद्युत हीटर, टोस्टर, केतली, प्रेस आदि में होता है।



चित्र 25.2

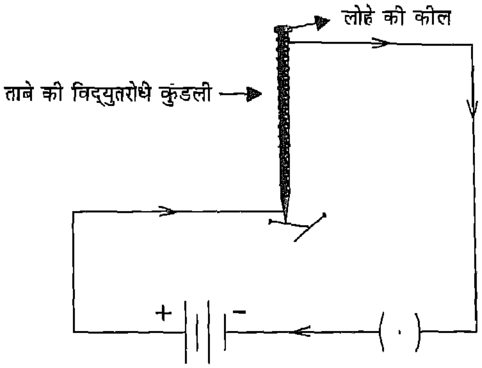
3. *विद्युत धारा का यांत्रिक प्रभाव :* विद्युत परिपथ (चित्र 25.3) के लिए विद्युत स्रोत को कुंजी के माध्यम से विद्युत घंटी से जोड़ते है। जब कुंजी को दबाकर विद्युत धारा प्रवाहित की जाती है तो घटी की कुंडली के चारों ओर चुंबकीय क्षेत्र (चुबकीय बल रेखाए अर्थात चुंबकीय फ्लक्स) बनता है। चुबकीय फ्लक्स में परिवर्तन होने से प्रेरित विद्युत वाहक बल बनता है। इस बल से घंटी की हथोड़ी में गति होती है जिससे घंटी में ध्वनि उत्पन्न होती है। इस परिघटना का उपयोग विद्युत घटी, विद्युत मोटर, विद्युत क्रेन, इंजन, मिक्सी आदि में होता है।



चित्र 25.3

4. *विद्युत धारा का चुंबकीय प्रभाव :* विद्युत परिपथ (चित्र 25.4) के लिए विद्युत स्रोत को कुजी के माध्यम से लोहे की कील से जोड़ते हैं। लोहे की कील (जिस पर तांबे की विद्युत रूद्ध कुंडली लिपटी हुई है) में कुंजी द्वारा विद्युत धारा प्रवाहित होती है तो उसके चारों ओर चुंबकीय क्षेत्र (चुंबकीय बल रेखाएँ) उत्पन्न होती है। चुंबकीय प्रेरण के कारण ये चुंबकीय बल रेखाएँ लोहे की (कील) छड़ में प्रेरित हो जाती हैं जिससे छड़ (कील) चुंबक की तरह व्यवहार करने लगती है। इस प्रकार बने चुंबक को विद्युत चुंबक कहते हैं।

5. *विद्युत धरा का रासायनिक प्रभाव* : नीले थोथे ($CuSO_4$) के जलीय विलयन में ताबे की छड़ (एनोड) तथा लेपन वाली वस्तु (कैथोड) को रखकर विद्युत धरा प्रवाहित करने पर $CuSO_4$ का Cu^{2+} तथा SO_4^{2-} आयनो में अपघटन हो जाता है। एनोड पर SO_4^{2-} पहुचकर Cu से क्रिया कर $CuSO_4$ तथा दो इलेक्ट्रान मुक्त करते है। कैथोड पर Cu^{2+} आयन पहुंचकर $2e^-$ ग्रहण करके Cu बनकर केथौड पर चिपक जाते है। यह क्रिया लगातार चलती रहती है जिससे ताबे की छड़ घुलती जाती है तथा कैथोड पर Cu की परत का लेप हो जाता है (चित्र 25.5)।



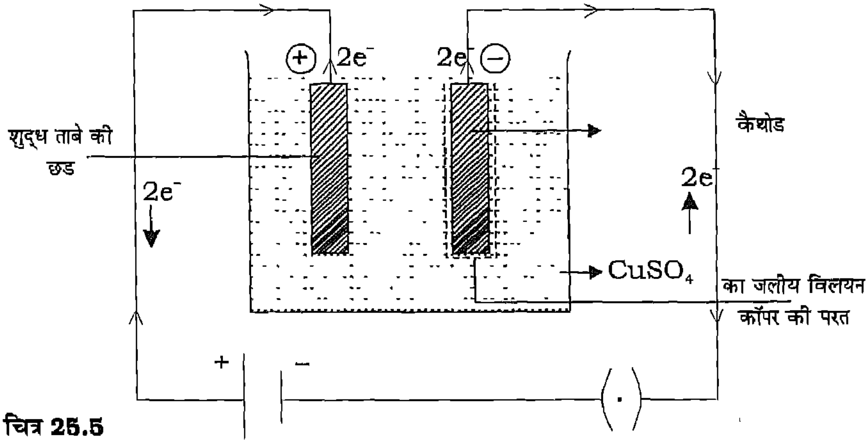
चित्र 25.4

रासायनिक क्रियाएँ

(अ) विलयन पर $CuSO_4 \rightarrow Cu^{2+} + SO_4^{2-}$

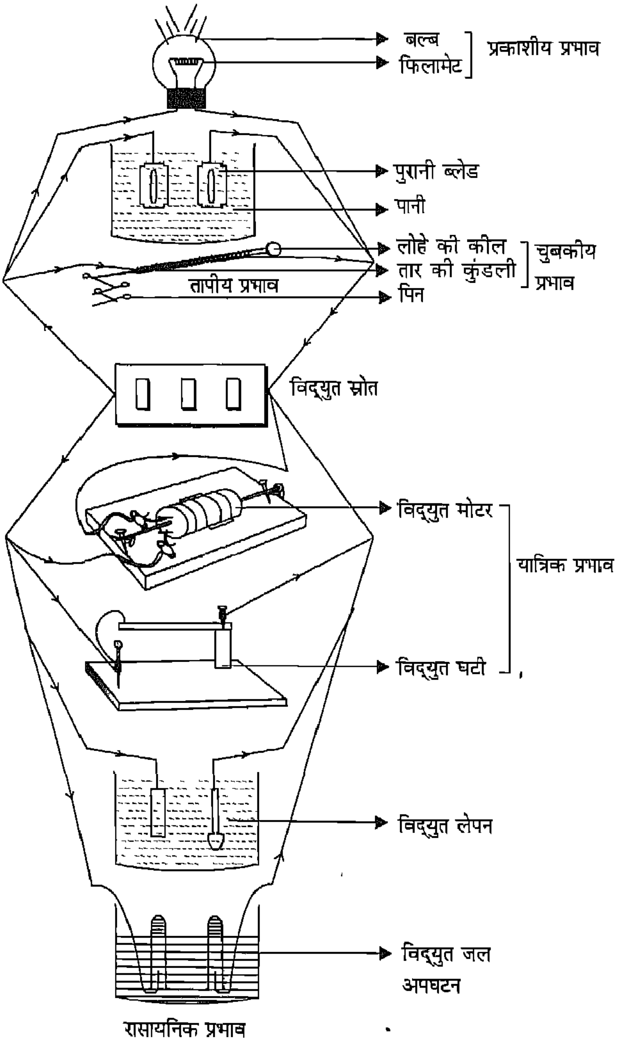
(ब) एनोड पर $Cu + SO_4^{2-} \rightarrow CuSO_4 + 2e^-$

(स) कैथोड पर $Cu^{2+} + 2e^- \rightarrow Cu$



चित्र 25.5

विद्युत धारा के प्रभावों तथा उपयोगों को सम्मिलित रूप से चित्र 25.6 मे दर्शाया गया है।



चित्र 25.6

26

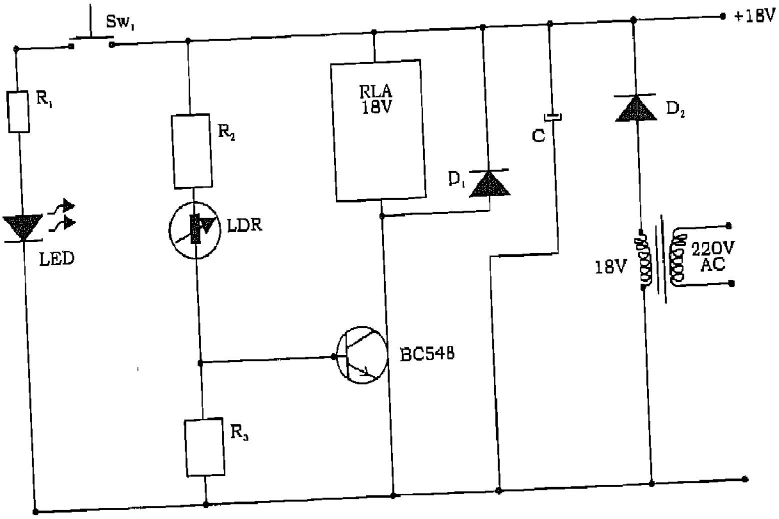
रेल पथ विच्छेदन सूचक

छात्र : नितिश मित्तल
शिक्षक : सजय पडलिया
बिपिन चंद्र पाडे

एच.एन. इटर कॉलेज, रामपुर रोड
हल्द्वानी, नैनीताल
उत्तरांचल

प्रस्तावना

इस प्रदर्श के निर्माण में बौद्धिक उद्देश्य रेल दुर्घटनाओ को रोकना है। यह यंत्र मुख्यत: फिश-प्लेटों के हटने से होने वाली दुर्घटनाओं की रोकथाम मे सहायक होगा। इसके अतिरिक्त किसी भी कारण से जैसे भू-हलचल या जमीन का धसना इत्यादि कारणो से यदि रेलपथ अपनी स्थिति से हट जाते हैं तब भी यह यत्र असामान्यता का सदेश निकटस्थ नियत्रण कक्ष को दे देता है। इसके नियत्रण कक्ष द्वारा स्वत: ही सबंधित क्षेत्र



चित्र 26.1

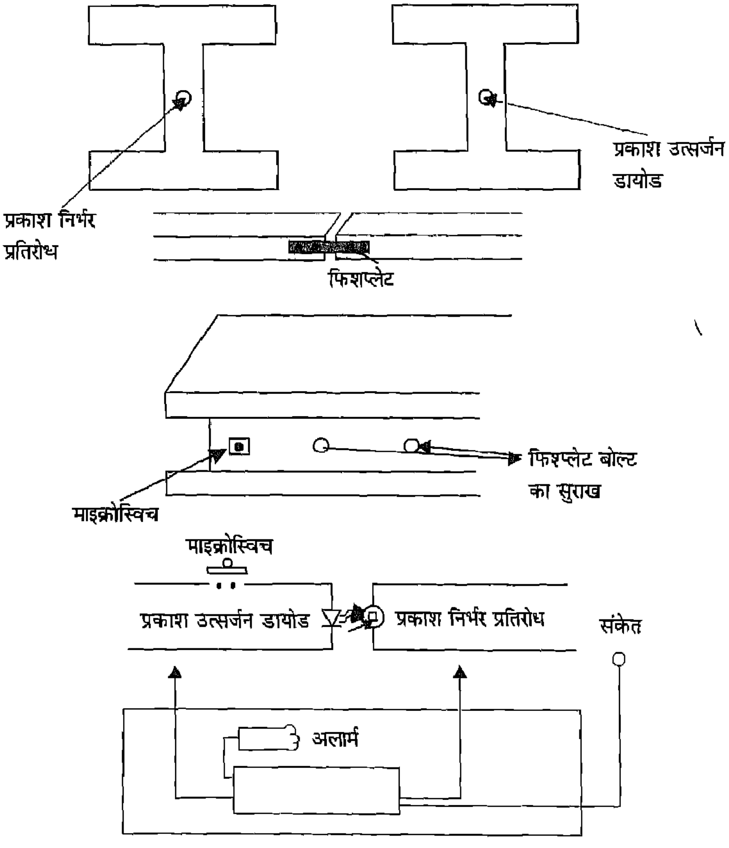
के सभी सिग्नल लाल हो जाते है। इस यंत्र के निर्माण मे प्रकाश के वैद्युतिक प्रभाव के सिद्धात का प्रयोग किया गया है।

प्रयुक्त सामग्री

प्रकाश उत्सर्जक डायोड, प्रकाश निर्भर प्रतिरोध, बजर, ट्रांसफॉर्मर (18V), रिले स्विच, प्रतिरोध, सधारित्र आदि।

संरचना तथा कार्य पद्धति

इस प्रदर्श में एक प्रकाश उत्सर्जक डायोड एवं प्रकाश निर्भर प्रतिरोध है जो कि रेल पथों में एक-दूसरे के सामने लगे हैं। प्रकाश उत्सर्जक डायोड को श्रेणीक्रम में लगे एक स्विच



चित्र 26.2

से जोड़ा गया है जो कि रेल पथो पर फिश प्लेटों के नीचे स्थित है (चित्र 26.1)। प्रकाश निर्भर प्रतिरोध का सबंध नियंत्रण कक्ष मे लगे परिपथ से है। उसी परिपथ द्वारा प्रकाश उत्सर्जक डायोड को भी विद्युत दी जाती है। सामान्य रेल पथ अवस्था में प्रकाश उत्सर्जक डायोड से निकलने वाली प्रकाश किरणें प्रकाश निर्भर प्रतिरोध पर पड़ती हैं जिससे प्रतिरोधक का मान घट जाता है तथा परिपथ में लगा हुआ रिले स्विच चालू हो जाता है जो कि नियंत्रण कक्ष मे लगे प्रकाश संकेत नियंत्रक पर कोई प्रभाव नहीं डालता तथा संकेत सामान्य रूप से काम करते है। यदि किसी कारण से पटरी के फिश प्लेट के नट बोल्ट खुल जाए या जानबूझ कर खोल दिए जाए तो रेल पथ मे लगा माइक्रो स्विच बद हो जाएगा तथा प्रकाश उत्सर्जक डायोड को विद्युत प्रवाह बंद हो जाएगा जिससे प्रकाश निर्भर प्रतिरोध का मान बढ़ जाएगा और नियत्रण कक्ष में लगा रिले स्विच बंद हो जाएगा जिससे प्रकाश संकेत नियंत्रक स्वत: लाल हो जाएगा एवं नियत्रण कक्ष मे लगा सूचक अलार्म बजने लगेगा। इस अवस्था में प्रकाश सकेत नियंत्रक द्वारा सकेतक को हरा नही किया जा सकेगा (चित्र 26.2)।

27

जल संरक्षक एवं लघु जल विद्युत घर

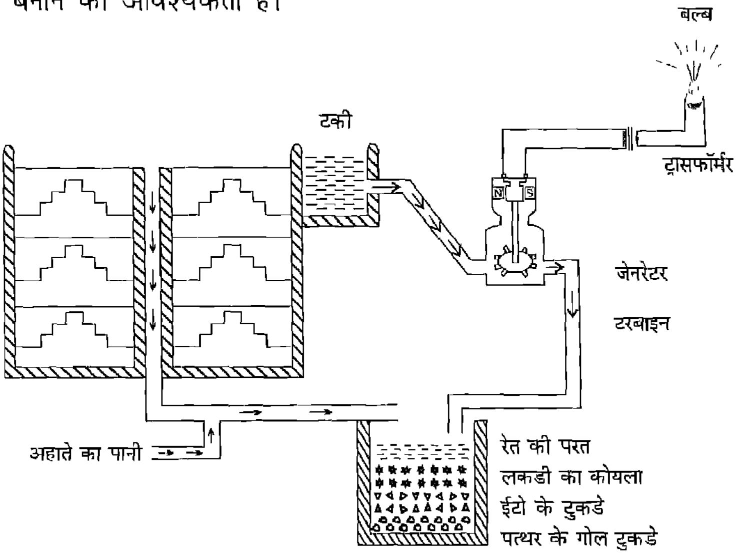
छात्र : गीतेश महतो
शिक्षक : संजय सोनी

महर्षि विद्या मदिर, मगला, बिलासपुर
जिला-बिलासपुर, छत्तीसगढ

प्रस्तावना

आम आदमी के जीवन की तीन मूल आवश्यकताएँ हैं — भोजन, पानी एव आवास परंतु आज के भौतिक युग में बिजली भी मूल आवश्यकता की श्रेणी मे शामिल हो गया है। वर्तमान मे बिजली एव पानी की समस्या आम हो गई है। विगत कुछ वर्षो से गर्मी के मौसम में प्रत्येक समाचारपत्रो एव अन्य सचार माध्यमों मे यह समाचार मुख्य रहता है कि अनेक स्थानो मे कुएं, तालाब आदि सूख चुके है, हैंड पपो में पानी आना बंद हो चुका है, जानवरों एवं मनुष्यों के लिए पीने व अन्य उपयोग हेतु पानी के लिए त्राहि-त्राहि मची हुई है। यह समस्या दिनो-दिन बढ़ रही है जिसने एक विक्राल रूप धरण कर पृथ्वी पर जीवन को कठिनाई में डाल दिया है। इसका मुख्य कारण भू-जल स्तर गिरना है। भूजल स्तर गिरने एवं समुद्र जल स्तर बढ़ने से भविष्य के प्रति सकट के लिए पूरे विश्व मे वैज्ञानिक चिंतित हैं। इस समस्या का मुख्य कारण पर्यावरण के नुकसान से वर्षा का असतुलित एवं खंडित होना, वर्षा जल का बेकार बह जाना एवं भू-जल का अत्यधिक दोहन है। प्राय: देखा जाता है कि कहीं अतिवृष्टि तो कहीं सूखा पड जाता है। अतिवृष्टि का जल नालो, नदी आदि से बहते हुए समुद्र मे समाहित हो जाता है अत: वर्षा जल को बहने से रोकने की आवश्यकता है। इसके लिए सरकारी प्रयासों के साथ-साथ आम लोगो की भी भागीदारी आवश्यक है। अत: इस हेतु जन जागरण एवं पोलियो मुक्ति जैसे दृढ़ सकल्पित सरकारी आंदोलन की आवश्यकता है। प्रत्येक क्षेत्र में वर्षा के जल को रोकने से जहां पर्यावरण सरक्षण को मदद मिलेगी, भविष्य में वर्षा भी संतुलित होगी। वर्षा के जल को रोककर विद्युत उत्पादन के विकल्प

के रूप मे प्रयोग कर बढ़ते हुए विद्युत सकट से भी कुछ हद तक मुक्ति मिल सकती है। बिजली की बचत के साथ-साथ बिजली के उत्पादन के छोटे-छोटे वैकल्पिक स्रोतो की भी आवश्यकता है जिसके लिए वर्षा का जल उपयुक्त है। वर्षा जल रोकने के लिए घरों के आहते में सोख-पीट निर्माण के साथ-साथ बाहर कुए, तालाब, खेतो के किनारे गड्ढे, ग्रामीण नालो एव नहरों मे छोटे-छोटे बांध एव पहाड़ो के कटाव एव ढलान में भी बांध बनाने की आवश्यकता है।



चित्र 27.1

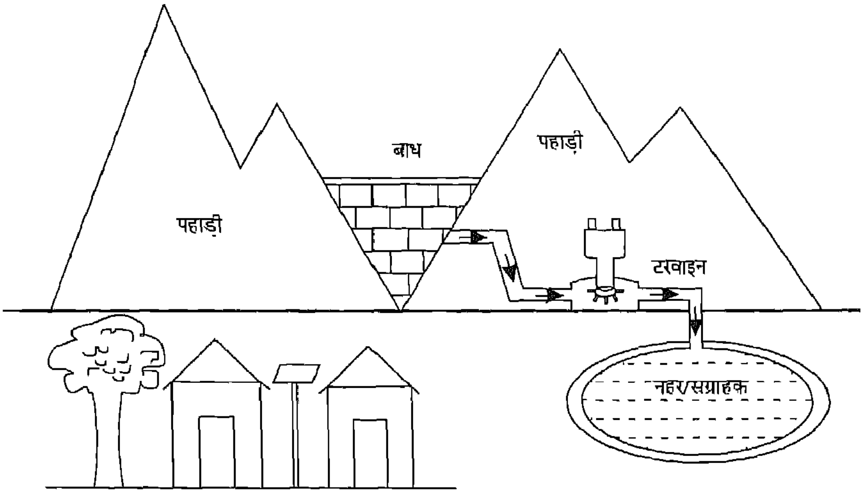
समाविष्ट वैज्ञानिक सिद्धात

भूमि की सरंध्रता के कारण वर्षा जल को सोखना, तरलीय गुण के कारण वर्षा जल का निचली सतह की ओर बढ़ना इसे विभिन्न माध्यमों द्वारा अधिक मात्रा मे रोकना, इस जल मे स्थैतिक ऊर्जा पैदा होना, इसे ऊपर से नीचे बहाने पर उसमें गतिज ऊर्जा से टरबाइन एव जेनरेटर घुमाना, जिससे जेनरेटर द्वारा गतिज ऊर्जा को विद्युत ऊर्जा मे बदलना, इस ऊर्जा की क्षमता को ट्रांसफॉर्मर द्वारा कम ज्यादा करके उसका उपयोग करना यही वैज्ञानिक सिद्धात है जिनके आधार पर यह प्रदर्श तैयार किया गया है। इस प्रकार की उत्पादित विद्युत की वोल्टेज की मात्रा जेनरेटर के क्वाईल की टर्न की संख्या, मेग्नेटिक फील्ड की शक्ति और उसके घूमने की गति पर निर्भर करता है। वर्षा का जल जब भूमि पर पडता है तो उसे जमीन सोखने लगती है। अधिक वर्षा होने पर जमीन की सोखने की क्षमता कम होने के कारण वर्षा जल जमीन मे बढ़ना शुरू हो जाता है।

इस प्रकार यह नालों, नदियो मे बहते हुए समुद्र मे जाकर बेकार हो जाता है। यदि इस वर्षा जल को किसी माध्यम से रोका जाए तो इस जल को धीरे-धीरे भूमि सोखती रहेगी जिससे भू-जल स्तर बढ़ेगा एवं इस रोके हुए जल से उपर्युक्त सिद्धांत के अनुसार लघु रूप मे विद्युत उत्पादन की जा सकेगी।

प्रयुक्त सामग्री

इस प्रदर्श को बनाने के लिए साईकल का डायनमो, टरबाइन हेतु कूलर पप का पखा, प्लास्टिक का गोल डिब्बा, प्लास्टिक पाईप एवं वाल्व, घरो एव पहाड़ो तथा जंगलो आदि को दिखाने के लिए थर्मोकोल, सोख-पीट के लिए पत्थर, ईट के टुकड़े, लकड़ी के कोयले एवं रेत का उपयोग किया गया है। उत्पादित विद्युत के उपयोग को दिखाने के लिए एक ट्रासफॉर्मर लगाया गया है।



चित्र 27.2

संरचना

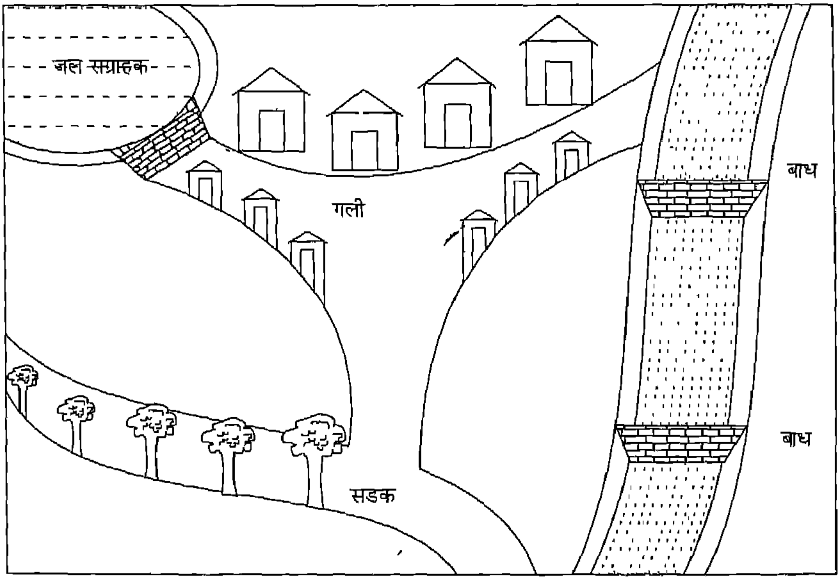
इस प्रदर्श को तीन अलग-अलग हिस्सो में बनाया गया है जो इसकी अलग-अलग क्षेत्र में उपयोगिता को दर्शाता है। इसके मुख्य भाग मे एक बड़ा भवन बनाया गया है, इस भवन के बाहर एक सोख-पीट का मॉडल बनाया गया है। सोख-पीट को ऐसे जगह मे बनाना चाहिए जहा घर के छत व उसके आहते का पूरा पानी उसमे चला जाए। इसमें

दिखाए गए है कि सोख-पीट बनाने के लिए जमीन को वर्गाकार में खोदकर उसमें पत्थर के गोलाई लिए हुए टुकड़े, ईटों के टुकड़े, लकड़ी के कोयले एवं रेत की परत बिछाई जाती है। वर्षा जल को इकट्ठा कर विद्युत उत्पादन दिखाने के लिए छत के पानी को इकट्ठा करने के लिए एक टकी बनायी गई है। टकी के पानी को पाईप द्वारा वाल्स से होते हुए टरबाइन मे जोडा गया है। टरबाइन से जो पानी निकलता है उसे सोख-पीट में जाते दिखाया गया है।

टरबाइन एव जेनरेटर को दिखाने के लिए कूलर-पप का पखा एवं साईकल का डायनमो उपयोग किया गया है। दूसरे व तीसरे हिस्से में वर्षा के जल को गावों एवं नालो, नहरों तथा पहाड़ी क्षेत्रों मे छोटे-छोटे बांध बनाकर रोकने एवं उससे विद्युत उत्पादन हेतु तरीका बताया गया है।

कार्य पद्धति

जब वर्षा होती है तो घर की छत एवं आहते का पानी सोख-पीट द्वारा सोख लिया जाता है। नालो एव नहरो में बाध बनाने पर वह भी सोख-पीट की तरह कार्य करता है। गांवो के गलियो के पानी को गाव के बाहर तालाब बनाकर इकट्ठा किया जा सकता है। इस प्रकार एकत्रित किए गए वर्षा जल से बताए गए सिद्धांत के अनुसार विद्युत को पैदा किया जा सकता है। विद्युत का उत्पादन दिखाने के लिए इस प्रदर्श के टरबाइन के घूमने



चित्र 27.3

पर सजीव रूप से बिजली उत्पादित होते दिखाया गया है। इसके लिए टरबाइन मे (टेप) नल से पाईप लगाकर पानी जाते दिखाया गया है। जब इस पाईप मे लगा हुआ वाल्व खोल दिया जाता है तो पानी फोर्स से जाकर टरबाइन व जेनरेटर को घुमाता है। इसमे दिखाया गया है कि विद्‌युत के ए.सी. वोल्टेज को ट्रांसफॉर्मर से कम ज्यादा किया जा सकता है। इस प्रकार यह प्रदर्श अपनी कार्य प्रवृत्ति के अनुसार वर्षा के जल को संरक्षित करते हुए उससे विद्‌युत उत्पादन विभिन्न जगहो पर करने के लिए उपर्युक्त बताया गया है।

उपयोगिता

इस प्रदर्श के अनुसार वर्षा ऋतु के बेकार बहने वाले जल को रोकना और उससे भू-जल स्तर बढ़ाना तथा उससे विद्‌युत उत्पादन करना इसकी मुख्य उपयोगिताएं है।

28

सरल, सस्ता वाटर हीटर एवं गर्म पानी संग्राहक

छात्रा : चुड़ासमा स्वाती आर.
चट्टनी जिज्ञा डी.
शिक्षक : याकूब एम. शेख

राजकीय बालिका उच्च विद्यालय
दीव

भूमिका

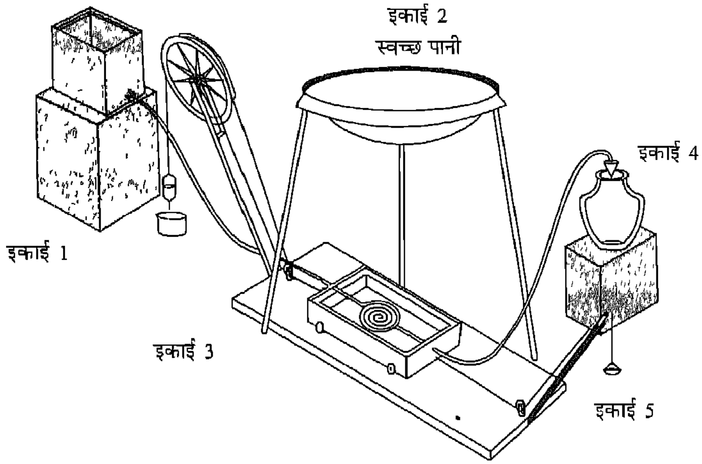
इस प्रदर्श मे सरलता से उपलब्ध पदार्थो के उपयोग से ऊर्जा के उपयोगों तथा ऊर्जा की बचत के महत्त्व पर बल देने का प्रयास किया गया है। इस कार्यकारी मॉडल मे ऊष्मा के उचित शोषण हेतु काले रग मे रंगे ताबे के उच्च ऊष्माशाषी बर्तनो के उपयोग द्वारा सौर ऊर्जा का ऊष्मीय ऊर्जा मे रूपातरण दर्शाया गया है।

प्रयुक्त सामग्री

धातु का डिब्बा और बक्से, साईकिल की रिमे, लोहे की सलाखों से बना स्टेंड, पारदर्शी काच और प्लास्टिक के पात्र, काला रंग, मिट्टी का मटका, ताबे की नली, लकड़ी का चूरा, सूखी घास, थर्मोकोल, घिरनी, चिकनी सतह वाला प्लेटफॉर्म आदि।

बनावट

यह प्रदर्श पाच इकाईयों से बना हुआ है (चित्र 28.1)। इकाई नंबर एक मे एक धातु के डिब्बे को काले रग से रगकर उसमें पानी भर कर इस डिब्बे के ऊपर की ओर रबरवाली फ्रेम पर एक पारदर्शी कांच रखा गया है। इस इकाई को ऊँचे स्टैंड पर सूर्य



चित्र 28.1

प्रकाश में रखा जाता है। इकाई नबर दो में एक लोहे के स्टेड पर साईकिल की रिम को रखकर पारदर्शी प्लास्टिक बाधकर उसमे स्वच्छ पानी भरा जाता है। इस इकाई को भी सूर्य के प्रकाश में रखा जाता है।

इकाई नंबर तीन में दो धातु के बक्सो के बीच खोखला थर्मोकोल रखा गया है। बीच वाले छोटे बक्से में तांबे की खोखली नली को वर्तुलाकार बनाकर उसके दो छोर दोनों ओर निकाले गए हैं। बीच वाला बक्सा और ताबे की नली को काले रग से रंगा गया है। यह बक्से के ऊपर दो पारदर्शी कांच रबरवाली फ्रेम पर रखे गए हैं। इस इकाई को इकाई नंबर दो के नीचे रखा जाता है।

इकाई नंबर चार में एक साधारण मिट्टी के मटके की बाहरी सतह पर रद्दी कागज, सूखी घास, लकड़ी के चूरे का आवरण लगाकर ऊष्मा अवरोधक बनाया गया है। इन चार इकाईयो को खोखली नली के द्वारा एक-दूसरे से जोड़ा गया है।

इकाई नबर पांच में सूर्य की गति के साथ बक्सा भी योग्य गति से पूरब से पश्चिम की ओर खिसकता रहे, जैसी सरल यात्रिक रचना की की गई है।

कार्यविधि

प्रथम इकाई में काला रंग ऊष्मा शोषक होने से डिब्बे का पानी सौर ऊर्जा से गर्म होता है (इकाई 1)। डिब्बे के ऊपर रखा हुआ पारदर्शी काच डिब्बे की ऊष्मा को व्यय होने से रोकता है। यह डिब्बे का पानी मंद गति से इकाई नंबर तीन मे आता है। इकाई नंबर दो पर सौर प्रकाश पानी के माध्यम से हवा के माध्यम में आते ही बहिर्गोल (उत्तल)

लेस के नियमो के अनुसार है और इकाई नंबर तीन के धातु के बक्सो पर एकत्र किरणो की ऊर्जा जमा होती है। धातु का बक्सा हवाचुस्त और ऊष्मा अवरोधक बना होने से बीच वाले छोटे बक्से मे लगभग 80 डिग्री से 100 डिग्री सेल्सियस तक गर्म हो जाता है। इस गर्म पानी को ऊष्मा अवरोधक मिट्‌टी के मटके में जमाकर मटके को बद कर दिया जाता है। यह मटके का पानी हमें सुबह तक करीबन 30 डिग्री से 40 डिग्री सेल्सियस तक गर्म मिलता है (इकाई 4)।

बक्से को सूर्य की गति के साथ रखने के लिए बक्से की पूरब की ओर की बोतल से पानी योग्य मात्रा में कम होता जाता है जबकि पश्चिम की ओर रखा गया भार बक्से को योग्य गति से पश्चिम की ओर खींचता है (इकाई 5)। इस प्रकार यह सरल यान्त्रिक रचना बक्से को सूर्य की किरणो की दिशा मे रखती है ताकि सौर ऊर्जा का अधिकतम उपयोग तथा संग्रह हो सके।

उपयोगिता

1. ऊर्जा की बचत होती है।
2 कम आमदनी वाले लोग सरलता से बना सकते है।
3. सरल तकनीक मे लोगों का विश्वास बढ़ता है।
4. आर्थिक बचत होती है।
5. वैज्ञानिक सिद्धातो का व्यावहारिक उपयोग होता है।
6. पर्यावरण का संरक्षण होता है।
7. लोगो मे वैज्ञानिक रस एव रुचि पैदा होती है।

F-23762
19/7/04